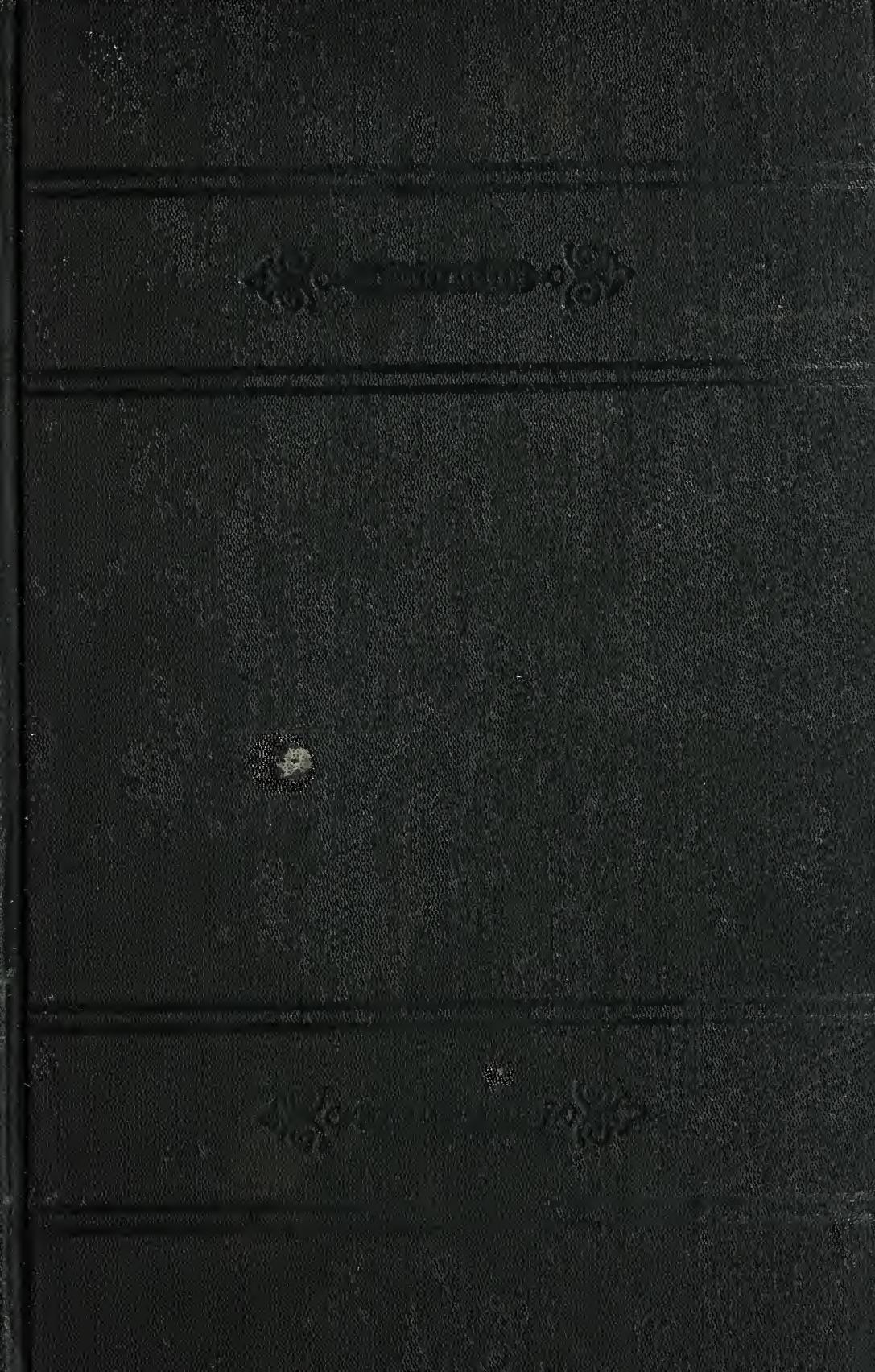


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U. S. DEPARTMENT OF AGRICULTURE.

ANNUAL REPORT

OF THE

OFFICE OF EXPERIMENT STATIONS

FOR THE YEAR ENDED JUNE 30,

1911.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1912.

JOINT RESOLUTION Providing for printing annually the Report of the Director of the Office of Experiment Stations, Department of Agriculture.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed eight thousand copies of the Report of the Director of the Office of Experiment Stations, prepared under the supervision of the Secretary of Agriculture, on the work and expenditures of that office and of the agricultural experiment stations established in the several States and Territories under the act of Congress of March second, eighteen hundred and eighty-seven, for nineteen hundred and three, of which one thousand copies shall be for the use of the Senate, two thousand copies for the use of the House of Representatives, and five thousand copies for the use of the Department of Agriculture; and that annually hereafter a similar report shall be prepared and printed, the edition to be the same as for the report herein provided.

Approved, April 27, 1904.

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 Mrs. C. E. JOHNSTON, Chief Clerk.
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 W. H. EVANS.
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 C. A. SAHR, Assistant in agronomy.

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Agent.—J. W. LONGSTRETH, in charge of work in Kansas.

Expert mechanician.—E. J. HOFF.

Irrigation farmers.—J. H. GORDON; R. G. HEMPHILL, B. S.; W. H. LAUCK; R. E. MAHONEY; and JOHN KRALL, jr.

Collaborators.—O. V. P. STOUT, C. E., Nebraska, University of Nebraska; W. B. GREGORY, M. E., in charge of pumping for rice investigations, Tulane University, New Orleans, La.; V. M. CONE, B. S., in charge of work in Colorado, State Agricultural College; S. H. BECKETT, B. S., California, University of California.

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¹ On furlough; in charge of irrigation census, Bureau of the Census.

LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., July 1, 1912.

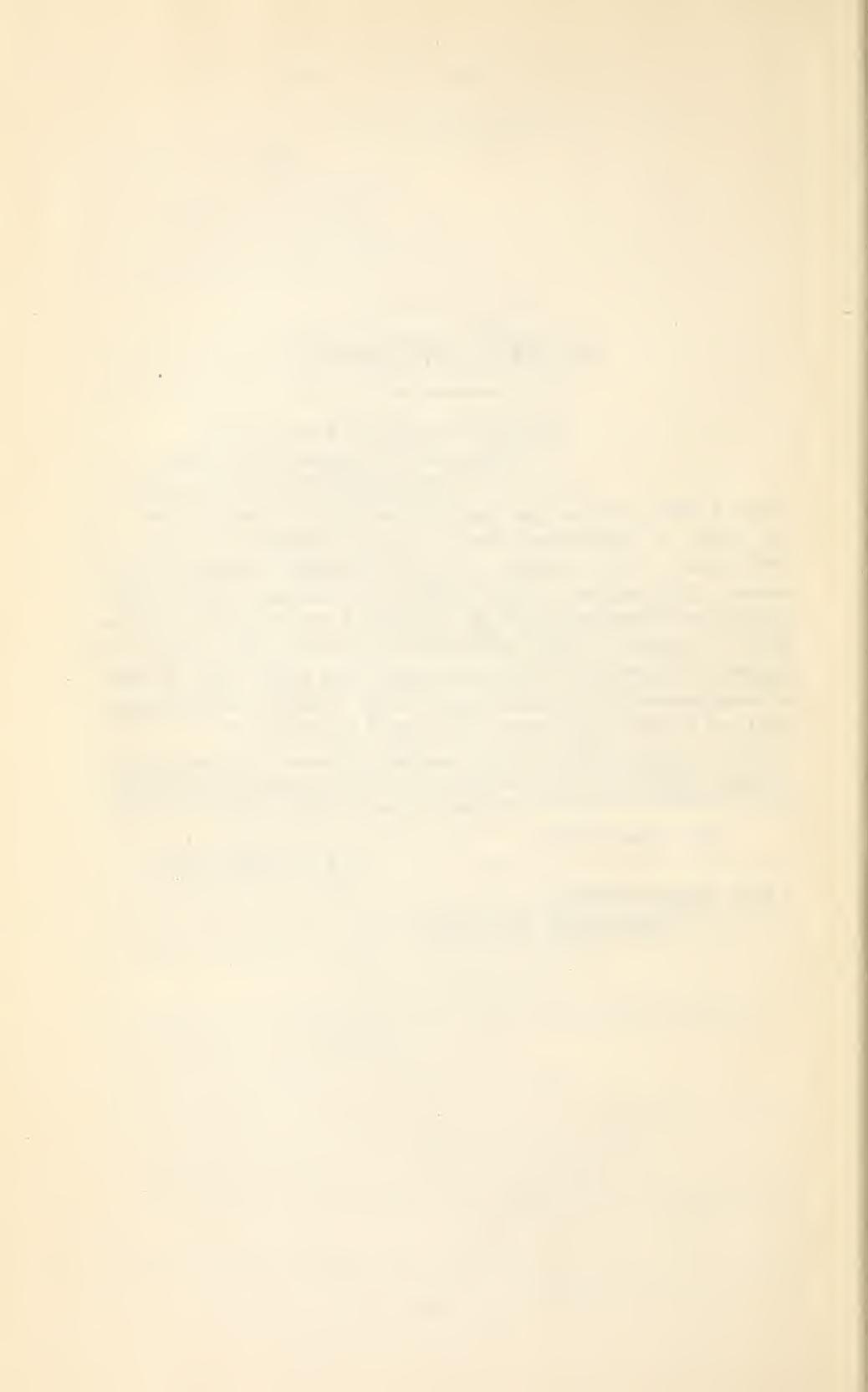
SIR: I have the honor to transmit herewith the annual report of the Office of Experiment Stations, the publication of which is authorized by joint resolution of the Fifty-eighth Congress, second session. This includes a report on the work and expenditures of the agricultural experiment stations established under the act of Congress of March 2, 1887, and further endowed under the act of Congress of March 16, 1906, for the fiscal year ended June, 30, 1911, in compliance with the following provision of the act making appropriations for this department for the said fiscal year:

The Secretary of Agriculture shall prescribe the form of the annual financial statement required under the above acts, ascertain whether the expenditures are in accordance with their provisions, and make report thereon to Congress.

Very respectfully,

A. C. TRUE, *Director.*

Hon. JAMES WILSON,
Secretary of Agriculture.



CONTENTS

	Page.
Work of the Office of Experiment Stations.....	13
Relations with the agricultural experiment stations.....	13
Insular experiment stations.....	15
Alaska stations.....	16
Hawaii station.....	20
Porto Rico station.....	24
Guam station.....	27
Nutrition investigations.....	30
Irrigation investigations.....	33
California.....	33
Colorado.....	34
Kansas.....	34
Montana.....	34
Nebraska.....	34
Nevada.....	34
Oregon.....	35
Wyoming.....	35
Cooperation with the Bureau of the Census.....	35
Aid to settlers.....	36
Use of water.....	37
Management of irrigation enterprises.....	39
Drainage investigations.....	40
Improvement of farm lands.....	41
Drainage of swamp lands.....	42
Reclamation of overflowed lands.....	44
Drainage of irrigated lands.....	45
Technical investigations.....	46
Preliminary examinations and reconnoissance.....	47
Dissemination of information.....	47
Promotion of agricultural education.....	48
Farmers' institutes and extension work.....	50
Publications.....	51
Income.....	52
Work and expenditures of the agricultural experiment stations.....	53
Review of the year.....	53
Increase in funds and equipment.....	55
Substations and demonstration farms.....	58
Changes in personnel.....	60
Dr. Edward B. Voorhees.....	60
Some results of station work.....	62
Progress in foreign countries.....	66
Inspection of the stations.....	68
Alabama College station.....	68
Alabama Tuskegee station.....	71
Alaska stations.....	72
Arizona station.....	74
Arkansas station.....	76
California station.....	78

Work and expenditures of the agricultural experiment stations—Continued.

Inspection of the stations—Continued.

	Page.
Colorado station.....	81
Connecticut State station.....	84
Connecticut Storrs station.....	87
Delaware station.....	89
Florida station.....	91
Georgia station.....	93
Guam station.....	95
Hawaii station.....	97
Idaho station.....	99
Illinois station.....	102
Indiana station.....	105
Iowa station.....	109
Kansas station.....	113
Kentucky station.....	115
Louisiana stations.....	118
Maine station.....	121
Maryland station.....	123
Massachusetts station.....	126
Michigan station.....	130
Minnesota station.....	133
Mississippi station.....	137
Missouri College station.....	140
Montana station.....	143
Nebraska station.....	146
Nevada station.....	150
New Hampshire station.....	152
New Jersey stations.....	155
New Mexico station.....	158
New York State station.....	161
New York Cornell station.....	165
North Carolina College station.....	168
North Carolina State station.....	171
North Dakota station.....	172
Ohio station.....	176
Oklahoma station.....	180
Oregon station.....	182
Pennsylvania station.....	185
Pennsylvania State College Institute of Animal Nutrition.....	187
Porto Rico station.....	188
Rhode Island station.....	191
South Carolina station.....	194
South Dakota station.....	198
Tennessee station.....	201
Texas station.....	203
Utah station.....	206
Vermont station.....	210
Virginia station.....	213
Virginia truck station.....	215
Washington station.....	216
West Virginia station.....	220
Wisconsin station.....	223
Wyoming station.....	227

	Page.
Statistics of land-grant colleges and agricultural experiment stations, 1911.....	231
Summary of statistics of land-grant colleges.....	231
Summary of statistics of the stations.....	233
Statistics of the land-grant colleges and universities.....	235
Statistics of the agricultural experiment stations.....	260
Progress in agricultural education, 1911.....	277
Summary for the year.....	277
Educational work of the Department of Agriculture.....	278
Educational work of the Office of Experiment Stations.....	280
Relation to American institutions.....	281
Relation to foreign institutions.....	282
Africa.....	282
Argentina.....	282
Australia.....	282
Belgium.....	283
British islands.....	284
British West Indies.....	288
Canada.....	288
Central America.....	289
France.....	289
Germany.....	290
India.....	291
Mexico.....	291
New Zealand.....	292
Russia.....	292
Sweden.....	293
Educational work of the Association of American Agricultural Colleges and Experiment Stations.....	293
Work of the National Education Association.....	301
San Francisco meeting.....	301
Mobile meeting.....	304
A new association of agricultural educators.....	305
Agricultural education at the Conference for Education in the South.....	306
Agricultural education at other conventions.....	308
The Graduate School of Agriculture.....	311
The agricultural colleges.....	318
Appropriations.....	318
Buildings.....	319
Work of the colleges.....	321
Training of teachers.....	323
Extension and short courses.....	324
The secondary schools.....	326
Recent progress by States.....	326
Alabama.....	326
Arkansas.....	326
California.....	327
Colorado.....	327
Idaho.....	328
Illinois.....	328
Iowa.....	328
Kansas.....	328
Louisiana.....	329
Maine.....	329
Maryland.....	329

Progress in agricultural education, 1911—Continued.

The secondary schools—Continued.

	Page.
Recent progress by States—Continued.	
Massachusetts	329
Minnesota	330
Mississippi	330
Nebraska	330
New Jersey	331
North Carolina	331
North Dakota	332
Ohio	332
Pennsylvania	332
Texas	332
Utah	334
Vermont	334
Wisconsin	334
Agriculture in State normal schools.....	335
The elementary schools.....	336
Connecting the school with the farm home.....	338
Farmers' institutes and extension work in the United States, 1911.....	343
Institutes held	343
Sessions	343
Attendance	343
Appropriations	344
Agricultural college and experiment station aid	344
Special institutes	344
Agricultural college extension work	345
American Association of Farmers' Institute Workers	346
Farmers' institutes for young people	348
Women's institutes	349
Exhibits at fairs	350
Agricultural instruction trains	352
County agricultural experts	354
Teaching by correspondence	357
The work of the farmers' institute division	363
State reports	367
Statistics of farmers' institutes, 1911	382

ILLUSTRATIONS.

PLATES.

	Page.
PLATE I. Fig. 1.—Movable poultry houses, Iowa station. Fig. 2.—Orchard heating to prevent injury from spring frosts, Iowa station.....	108
II. Fig. 1.—Industrial alcohol plant, Minnesota station. Fig. 2.—Flour-testing laboratory, Minnesota station.....	108
III. A study of the principles of mule breeding, Mississippi station. Fig. 1.—Yearling mule colts out of thoroughbred mares, weights 654 and 660 pounds. Fig. 2.—Yearling mule colts out of Clyde mares, weights 770 and 780 pounds.....	136
IV. A study of the principles of mule breeding, Mississippi station. Fig. 1.—Two-year-old colts, on right out of native mare, on left out of thoroughbred mare, weights 880 and 780 pounds. Fig. 2.—Two-year-old mule colts out of Clyde mares, weights 1,100 and 1,000 pounds.....	136
V. Fig. 1.—New greenhouse attached to agricultural building, Montana station. Fig. 2.—Experimental steer-feeding plant, constructed of hollow tile with cement stucco finish, Nebraska station.....	144
VI. Meteorological and climatological observations, Nevada station. Fig. 1.—Refuge camp and headquarters for snow measurements on Mount Rose. Fig. 2.—Summit station, Mount Rose Observatory (altitude, 10,800 feet).....	144
VII. Studies of inheritance of characters in melons, New Hampshire station. Fig. 1.—Growing melons for crossing in greenhouse. Fig. 2.—Parents and offspring in melon crosses.....	161
VIII. Fig. 1.—Nutrition-experiments building, Ohio station. Fig. 2.—Soil laboratory, Ohio station.....	161
IX. Fig. 1.—New greenhouse, Vermont station. Fig. 2.—New horticultural building, Wisconsin station.....	208
X. Women's building, Oklahoma College.....	328
XI. Fig. 1.—Forest-products laboratory, University of Wisconsin. Fig. 2.—Class in stock judging, Third District Agricultural School, Magnolia, Ark.....	328
XII. Fig. 1.—Dining hall, Third District Agricultural School, Magnolia, Ark. Fig. 2.—Main building, Fourth District Agricultural School, Monticello, Ark.....	328
XIII. Fig. 1.—Interior of cloth house made by the farm-mechanics class, Gardena Agricultural School, Los Angeles, Cal. Fig. 2.—Ear-row seed-corn test on the Bakersfield (Cal.) High School farm.....	328
XIV. Fig. 1.—Boys making tile for irrigating system at Bakersfield (Cal.) High School. Fig. 2.—Greenhouse erected by the students of the Oxnard (Cal.) High School.....	328
XV. Fig. 1.—Home economics demonstration at a mothers' meeting, Tuleta (Tex.) High School. Fig. 2.—Farmers' club meeting at Tuleta High School.....	328

ANNUAL REPORT OF THE OFFICE OF EXPERIMENT STATIONS, 1911.

WORK OF THE OFFICE OF EXPERIMENT STATIONS.

The work of the Office of Experiment Stations during 1911 included, as in previous years, the supervision of the expenditures of Federal funds by the agricultural experiment stations in the several States; conferences and correspondence with station officers regarding the management, equipment, and work of the stations; the collection and dissemination of information regarding the progress of agricultural education and research throughout the world by means of technical and popular bulletins; the management of the agricultural experiment stations in Alaska, Hawaii, Porto Rico, and Guam; the promotion of the interests of agricultural colleges and schools and farmers' institutes throughout the United States; special investigations on irrigation and drainage, conducted largely in cooperation with experiment stations, educational institutions, and other agencies in different States and Territories; and the investigation of problems relating to the food and nutrition of man.

RELATIONS WITH THE AGRICULTURAL EXPERIMENT STATIONS.

The work and expenditures of the experiment stations have commanded much attention from this office during the year. The attention required has been in direct proportion to the increase in volume and variety of the station activities resulting from the greater amounts of Federal funds now available and the continued financial aid given the stations by most of the States. In the fiscal year 1911 the Adams fund reached its maximum of \$15,000, making, with the Hatch fund, a total of \$30,000 of Federal funds for agricultural experimentation for each State. In addition, many of the States are meeting the needs and requirements of their stations by appropriations for maintenance and for definite lines of work. The generally better financial status of the stations, as well as the demands of growing agricultural industries, tends to enlarge their scope of action and to increase their lines of work. This greater development of the institutions has demanded a more careful consideration of the ex-

penditures of all the different funds in order to determine the policy pursued in the use of the Federal funds. In this connection numerous questions have arisen with regard to the legitimate and most effective use of these funds for experimental and research work.

The increase in station resources and duties has involved a closer inspection and a stricter adherence to the policy of restricting the Federal funds to actual experimental work. As the law demands that the Federal funds shall be used chiefly for experimental and research work, it is practically imperative that the stations should have some other revenues upon which to draw for administrative needs, printing, and those lines of work often demanded by the State, such as inspection, demonstration work, and other duties which can lay no claim to being financed from the Federal funds. The restriction of the Hatch and Adams funds to experimental and research work has resulted in a more careful arrangement of the station budget for the entire year. This consideration of the needs of the different departments has brought about a more even and regular expenditure of funds, as well as a better and more efficient use of them.

The apportionment of salaries in cases where station officials also have college duties requires continued and careful supervision, mainly because this matter did not receive the requisite scrutiny at the proper time, and in many cases because the necessary arrangement was not made with the college authorities before entering upon the year's work.

The experimental work proposed and submitted for approval under the Adams fund was subjected to more searching scrutiny, which required a more extensive correspondence regarding the work before it was entered upon. In this manner a full understanding with reference to the methods and purposes of the proposed investigation was brought out and the work was placed on a proper basis. The policy that the work submitted must be definite, restricted, and specific was also more rigidly enforced. The experience with the Adams fund work in general has clearly shown the advisability of approving only projects properly limited in scope and definite in purpose and methods. The legality of the expenditures is so largely dependent upon the character of the investigation that the supervision of the funds requires much careful study of the investigations as far as their character, origin, features, and continuity are concerned. The situation is often complicated by the partial support of the projects from other funds and by the extent to which the Adams fund is divided among relatively small undertakings and a large number of workers.

The expansion of the work of the stations in various directions involves heavy administrative burdens and tends to draw into the

service men of limited experience and scientific training. These and other conditions often give rise to what is involved in a study of individual problems, and this office, therefore, is often called upon to act in an advisory capacity regarding planning and execution of research. In doing this it endeavors to give these stations the benefit of its broad study of the world's literature of agricultural science and its knowledge of the conditions under which agricultural research is being conducted in many institutions at home and abroad.

Increased attention was also given to the Hatch fund and to the sales fund derived from the two Federal funds. It was held that these should be used primarily for definite experimental work and not for administrative or general running expenses or for demonstrations and other forms of extension work. The office has endeavored to assist the stations in working out the best methods of using the Federal and other funds at their disposal and of organizing other enterprises so as not to interfere with the more legitimate activities.

Regarding records of station work the office has maintained that these should be recognized as the property of the particular station at which or for which the work was done. Wherever it has been the intent to appropriate material taken away from the station by the individual worker on severing his connection with the institution and to use and publish it at an experiment station in another State, the office has refused to approve such a project without the consent of the station where the work was originally done.

The detailed review of the work and expenditures of all the stations for this fiscal year contains many evidences of substantial progress in research and the accumulation of useful and practical results. Never before was the stations' work so clearly defined and this function so fully appreciated by the general public.

INSULAR EXPERIMENT STATIONS.

An eminently successful year has been reported by each of the stations maintained by the office. A few changes in the personnel of some of the stations have been made, but there has been little interruption of the work. The policy adopted at the establishment of the stations of working for the diversification of agriculture remains unchanged.

The Alaska stations are continuing their investigations in agriculture, gardening, and stock raising with a view to ascertaining what crops, animals, and systems of management are adapted to that country. Gratifying results have been secured in the growing of small grains in the interior valleys of Alaska, and recent experiments have also demonstrated the possibility of potato growing on an ex-

tensive scale. In Hawaii and Porto Rico the investigations include experiments with all sorts of crops except sugar cane. In both countries sugar production is the leading industry and the planters have provided experiment stations for working out their especial problems. Fruit growing, forage production, the introduction of new crops and agricultural industries, live-stock improvement, etc., are receiving attention. At the Guam station the principal problems are the restoration of agriculture to its former importance, the improvement of live stock, and the introduction of new crops. The main features of the work at the different stations are briefly described in the subjoined reports.

All the stations are growing in the esteem and favor of the people for whom they are maintained. This is shown by the rapidly increasing growth in correspondence, in the demand for publications, and in individual requests for advice, the readiness to engage in cooperative work of all sorts, and the increasingly generous private and community contributions of funds. The scientific work of the stations is attracting wide attention, their publications being noted in the principal scientific review journals of the world, and in not a few instances permission has been given for the republication of some of the bulletins in foreign countries.

Through local funds, contributed for the purpose, there have been several additions to the cooperative demonstration farms maintained by some of the stations. It is expected on these farms to present visual evidence of some of the more practical results of the stations' work, while the more technical experiments are carried out on the station proper.

The several bureaus and offices of this department continue to cooperate generously with the stations, thus materially assisting in their work. It is desired to make proper acknowledgment for this aid.

The administrative work of the insular stations in their relations with the Office of Experiment Stations continues to be in charge of Dr. Walter H. Evans, as chief of the division of insular stations.

ALASKA STATIONS.

The reports from the Alaska stations for the past year have been very gratifying. An unfavorable spring was followed by many clear, warm days during the summer, and along the coast the growing season was prolonged well into autumn. The first destructive frost in the interior came the last night of August, but freezing weather did not come until the last of September. At Sitka freezing temperatures were not experienced until late in October. As a result of the favorable weather, all the usual crops were fully ripened and some that have hitherto been of doubtful adaptability were matured.

The work at the agricultural experiment stations in Alaska has been carried out during the past year in accordance with the plans outlined in former reports. At Sitka horticultural and plant-breeding work are given prominence. At Rampart the principal work is in testing and breeding varieties of grain and in experiments with potatoes and hardy leguminous plants. Farming on a commercial scale, as it must be practiced by settlers, is carried on at Fairbanks, and at Kodiak breeding and care of live stock are the principal investigations. For the present this work is confined to cattle and sheep.

The plant breeding work at the Sitka station is receiving much attention. The work with hybrid strawberries has been continued with marked success. Of the earlier hybrids produced by crossing the native strawberry of the coast region with a cultivated variety, nearly 200 have shown such valuable characters that they are being propagated and tested to determine their true value. About 35 varieties have already produced berries that exceed in size and flavor any of the cultivated ones found in the local markets, and 15 which have borne the largest and best berries have been selected for propagation. Ultimately some of these will be distributed for trial in other parts of the country. Continued efforts have been made to produce additional hybrids, and about 4,000 hybrid seedlings are now being grown at the station. These should begin to bear in two years and give some indication as to their value. In like manner the study of the crosses between the salmonberry and the cultivated raspberry is being continued. Thus far the hybrids have proved very shy bearers, and little judgment can be made as to their value.

Experiments were begun in 1903 with apple, cherry, plum, and other trees, a small test orchard being set with early varieties of each. During the past season the first apples were matured, six introduced varieties having borne fruit of medium size and good quality. About two dozen other varieties have not yet fruited. An experiment is in progress in hybridizing the native crab apple with pollen from other varieties. Some fruits were secured last year, but it will be a number of years before their seedlings will produce fruit to indicate their value. Four varieties of cherries have fruited for the past four years. One variety, Early Richmond, produced abundantly during the past year, and it seems better adapted to its surroundings than the others. The plums have not fruited. Gooseberries, currants, raspberries, and other bush fruits are receiving attention, and a number of varieties have been found adapted to Alaskan conditions. The station is continuing to propagate and distribute for trial a large number of fruit trees and bushes and some ornamental plants. These are furnished to settlers upon request, as far as the supplies will admit, and some are sent to the other stations, where

the facilities for propagation are not as complete as at the main station.

The work with vegetables has been reduced to the minimum at the Sitka station. It is no longer a question of the possibility of growing vegetables in Alaska, but which varieties give the best results. Comparative tests of about 60 varieties of potatoes and of many varieties of cabbage, cauliflower, and other vegetables are being continued to determine which varieties are best adapted to the climatic conditions of the coast region.

At the Rampart station 30 acres are now under cultivation, 4 acres having been added during the past year. The work here consists of testing varieties of grain, cross-breeding varieties that have shown desirable qualities, the introduction of hardy leguminous plants, and testing vegetables on a limited scale. At this station uniformly successful efforts in growing barley and oats have been made, but with rye and wheat less favorable results have been secured. The normal growing season is about 110 days, and in 1911 the maximum temperature was in June, when 91° F. was registered. The maximum for July was 89° and for August 85°. The daily mean temperatures during these months were: June, 59.4°; July, 63.09°; and August, 56.3°. This gave sufficient warmth to ripen practically all varieties of spring-sown grains except wheat. Where rye and wheat were sown in the fall and well covered with snow they came through the winter and matured a considerable portion of their crop. The spring of 1911 was abnormally late in starting, but spring-sown grains are reported as having done well. Winter rye and winter wheat were badly injured by severe freezing in the early winter before snow covered the ground. A number of successful crosses of varieties of barley have been made, and in the first generation some appear to have desirable qualities, but they will have to be grown longer to fix the varieties and determine their worth. In addition to the hybridization work selections of the earliest maturing and best individual plants from different varieties have been made for the past three years, the object being to secure pedigree stock of known superiority. This experiment is in progress with all grains now grown at the station. As a result of 10 years' work at this station, it appears that grain growing is practicable in the interior of Alaska, and that it can be made a success in many parts of the broad interior valleys.

An attempt is being made to introduce some of the Siberian alfalfas, brought to this country by Prof. N. E. Hansen, of the South Dakota Experiment Station, and there is reason to believe that some of them will become established, as the plants have withstood the winter without apparent injury. None of these plants formed seed,

and vegetative propagation is at present the only way to increase the supply.

An experiment with potatoes was carried on at Sitka, Fairbanks, and Rampart, with practically the same results at each station. The tubers of a number of varieties were placed in greenhouse flats covered with soil and allowed to sprout in the light for four weeks before planting. These yielded in nearly every instance an increase of 10 per cent or more in the total crop, with a proportionate increase in marketable tubers. By following this method and planting only those varieties that experience has shown are adapted to the country the production of potatoes of good quality in large amount is possible.

The Fairbanks station was largely established to determine the practicability of farming on a considerable scale. As a consequence the small plat and plant-breeding work have been reduced to a minimum, and all the force is applied to general farming and the further development of the station. With this in view, grain and potatoes were grown on a commercial scale. In 1910 over \$1,500 worth of potatoes, the surplus of the crop grown on $3\frac{1}{4}$ acres, were sold, and in 1911 on 7 acres the value of the potatoes grown was estimated at about \$2,500. In variety test plats yields of from 120 to 300 bushels per acre were obtained. The hay problem in the interior valleys of Alaska is an important one, and the station is giving especial attention to it. The production of grain hay has been completely demonstrated, and 30 tons of oat hay were produced on 25 acres of light soil in 1911. All early varieties of oats, barley, and fall grains, where the latter have had a good snow covering, have matured. The results with vegetables have been quite satisfactory, especially with cabbage, cauliflower, turnips, rutabagas, carrots, etc.

Since the last report 23 acres of land has been cleared. The station now has 93 acres of cleared land, 70 of which is in cultivation. The weather at Fairbanks was cool and wet in the spring, followed by warm weather with an unusual amount of sunshine during the summer. A frost on August 31 killed many tender plants, but the ground did not freeze enough to stop plowing until October 20.

Satisfactory progress is reported from the Kodiak station, where there are now 85 head of pure-bred Galloway cattle of all ages, 10 grade cattle, and 89 sheep and lambs. The stock is all healthy and thrifty and only 2 head of cattle and 6 of sheep died during the past year. The animals were successfully wintered on native forage, supplemented by a small amount of purchased grain feed, and there does not appear to be any reason why stock raising should not be made a success in the coast region of Alaska if care is exercised in selecting the stock and they are sufficiently well housed and winter fed.

The cattle secured sufficient grass to keep them in good condition until late in November, after which they were given a half ration of hay until December 11. From that time until April 15 they were regularly fed silage and hay at the rate of 30 pounds silage and 20 pounds hay for each mature animal. After May 9 the cattle were again able to get enough grass to supply their needs. The sheep wintered well and were in good thrifty condition in the spring. They were fed hay and silage for 3½ months. There was some loss from bears, as the sheep wandered into the mountains and could not be closely looked after. When sheared in June the fleeces of the ewes averaged 7 pounds. The wool was clean and of good quality.

Arrangements are being made to take up dairying as a part of the work at Kodiak, and an attempt will be made to select out the best milkers of the Galloway herd and purchase others to carry on this work. The demand for breeding stock is limited, at least for beef types, and it is hoped to develop a milking strain of Galloways that can be of general use in Alaska.

Over 100 tons of native grass hay and 170 tons of silage were put up during the past year. It is intended to grow about 40 acres of grain for hay as soon as other needed work at the Kodiak station is done.

Some additions have been made to the equipment of the stations, the most important of which are a stock and hay barn and an additional 100-ton silo at the stock farm on Kalsin Bay, and a silo and dairy barn at Kodiak; a barn, a well, and a frost-proof cellar at Fairbanks; and a barn and implement shed at Rampart.

A survey has been made of the tract of land occupied by the station on Kalsin Bay, and its reservation for station purposes has been asked.

HAWAII STATION.

The new office building provided for from Territorial funds has been occupied and serves exclusively for the library, general office, and office of the entomologist. The quarters of the agronomist are in one portion of the old office building, which has been completely remodeled to accommodate the work of the departments of chemistry and agronomy.

The portion of the ground turned over to the Department of Agriculture by the Navy Department which is situated on Magazine Hill has been cleared and planted to corn, cotton, and broom corn, and considerable success was obtained with corn, particularly with the variety Yellow Creole. A portion of the upper slope of the station, at an elevation of about 750 feet, has been cleared and planted to Caravonica cotton, in order to compare the growth of this variety at the higher and lower altitudes.

The investigations outlined in previous reports have been continued, and a number of new ones begun. The work with cotton continues to attract favorable attention, and it would seem that the profitableness of this new agricultural industry has been demonstrated. The results thus far obtained clearly justify the larger plantings which have been made. The returns coming in from the early crop show yields of from 400 to 600 pounds of lint per acre, and also indicate that a practical method of controlling the bollworm has been found. A number of plantings of cotton have been made from sea level to altitudes of 1,600 feet. The results that have been obtained with these plantings indicate that altitude alone does not determine success with cotton in Hawaii, nor has the amount of rainfall necessary for good crop production been definitely determined. Cotton makes its best and largest yields on lowlands and in places protected from strong winds. Experiments on the control of the Indian cotton bollworm by pruning have proved quite successful. The cotton is pruned back at the close of each picking season and all the rubbish burned. This destroys the larvæ and pupæ of the bollworm in the infested bolls, and the pruning interrupts the crop of bolls as completely as a new planting where the cotton is treated as an annual. Growth from pruned plants is considerably more rapid than that from seed, and the yield of such plants is larger than from seedlings the first year. A peculiar type of Caravonica cotton has been developed in which the lint is unusually harsh and strong. This seems particularly well suited for mixing with woolen goods, and reports received at the station on samples of the lint indicate that it will be readily purchased for that purpose. The quotations submitted by buyers and cotton graders on last year's crop were 40 cents for Sea Island, 28 cents for Sunflower, and 25 cents for Caravonica.

The Japanese rices imported by the station have been successfully grown, but their substitution for the imported rices has not been fully satisfactory. Some consumers have considered the Japanese rice grown in Hawaii equal in every way to imported Japanese rice, while others claim that it differs in certain indefinable qualities. The yields obtained from the Japanese varieties grown in Hawaii have been satisfactory. The experiments with fertilizing rice have shown definitely that the fertilizer should be applied before the rice is planted, and that as a source of nitrogen, ammonium sulphate or an organic fertilizer is better than nitrate of soda. In a similar manner it has been shown that the fertilization of taro should be the same as for rice, and the thorough drying and aeration of the soil between crops, together with proper fertilizing, was found to prevent taro rot. The results obtained by the station in these experiments with rice and taro have been put in practice by many small planters in their operations.

The chemical investigations have been continued along lines previously described. The results obtained in the work with manganese soils have added greatly to the knowledge of conditions which prevail in these soils and indicate that the pineapple is exceptionally sensitive to unfavorable soil conditions and can not be made to thrive where from 4 to 5 per cent or more of manganese is present. Other crops are less sensitive to manganese, among them sugar cane, corn, and cotton. If it is especially desired to grow pineapples on manganiiferous soils it has been found that the best results can be obtained by planting the old stumps rather than the suckers and by fertilizing heavily with phosphates. It appears from an examination that improper drainage of soil is a conspicuous cause of some of the pineapple troubles in the district of Wahiawa. It seems certain that pineapples do not require as much water as has been formerly supposed, and where proper drainage is supplied pineapples can be successfully grown in the presence of heavy rainfall. Data are being accumulated for a general classification of Hawaiian soils, some of which exhibit striking peculiarities. Localities are known where soils contain from 8 to 10 per cent of manganese, and in others there was found 20 per cent or more of titanium.

The most important feature of the entomological work during the year was the discovery of the Mediterranean fruit fly. Since this discovery the pest has spread with remarkable rapidity, attacking peaches, all of the citrus fruits, mangoes, peppers, guavas, figs, and avocados. The discovery of this pest in Hawaii led to the establishment of a quarantine on the part of California against Hawaiian fruits, except pineapples and bananas. The station has taken part in devising a plan for the control of this pest, which consists essentially in the collection and destruction of fallen fruit, and the results of the campaign are evident in the greatly reduced numbers of the fruit flies. Studies have been made of the insect pests of corn and leguminous plants during the year, and a bulletin prepared on the insect pests of corn. Some attention has been given to the subject of insect parasites, and a parasite which destroys from 5 to 10 per cent of the bollworms has been found.

The horticultural investigations have been continued with tropical fruits. During the past season a budding method has been perfected for the avocado by means of which success is obtained on young trees in from 85 to 90 per cent of cases, and by the top-working of old trees in from 50 to 75 per cent of all cases. In addition, a successful inarching method has been devised for rapidly testing promising seedlings. As far as possible, all types of avocados found in Hawaii have been collected and a system of classification and description is being worked out. Studies show that the variation in flavor, size,

and shape of papaya fruits is almost unlimited. The station has found it possible to propagate papayas by the use of monoecious trees without the help of sterile male trees. If it should prove a practical inatter to secure the desired flavor and other qualities by this method alone, it will thereby become possible to avoid the loss of space incident to the growing of a large number of male trees and the lack of uniformity which has hitherto occurred when dependence was placed on the fertilization of the pistils of one form of dioecious trees with the pollen of another form. Spraying experiments have shown that the rusty blight of avocado leaves can be controlled with Bordeaux mixture. A wide interest in banana culture has been aroused and the station is assisting it in the distribution of suckers of the Bluefields banana and in cultural experiments. From the latter it seems evident that a wider spacing in planting should be adopted, as the plants when given plenty of room are more robust and better withstand the strong winds.

A number of miscellaneous investigations are in progress, among them experiments with broom corn, and it has been found that a good quality of brush can be produced in Hawaii, somewhat superior to that grown in California and nearly equal to that obtained in the Central States. Extensive experiments with leguminous crops for a variety of purposes, including forage, are in progress, and the station is testing all leguminous plants which can be considered as suitable for Hawaii at various locations on the different islands. The results of these experiments are being quickly adopted by the planters and farmers. The possibility of weed destruction with arsenite of soda used as a spray solution has been thoroughly demonstrated, and during the past year about 2,000 acres of land were rid of shrubby and herbaeuous weeds. The station has other experiments in progress, among them the utilization of the pulp from sisal mills, fiber in banana stalks and pineapple leaves, the production of oil from kukui nuts, etc.

During the past year, under Territorial funds, the station has established three demonstration farms, one on Kauai and two on Hawaii. The problems at these different farms are essentially peculiar, but the results obtained will apply to a considerable area. The work will include the introduction of improved varieties, studies on better methods of handling the soil, agriculture in districts where the rainfall is very high, etc. In addition to the Territorial support, a number of private individuals and companies are assisting in carrying on these experiments.

Arrangements have been made with private individuals and companies for cooperative experiments with fertilizers for different crops, the growing of sweet potatoes, cotton culture, and other forms of diversified agriculture.

PORTO RICO STATION.

The work of the station during the year was continued along the well-planned lines previously described. Some few changes were made in the personnel of the station staff. The coffee investigations that had been carried on for nearly 10 years on the Carmelita plantation were brought to a close, and the work has been transferred to an old coffee plantation near the station. This makes possible a much wider field of investigations, as the members of the staff can personally supervise their experiments much better than formerly.

The lowlands of the station have been drained with earthen tile made on the premises, and the value of the tile drainage is very evident. During the year a machine was purchased for the manufacture of cement tile, and tile of this kind will, it is thought, be less expensive, as less labor is required in its manufacture and there is no expense for burning, as in the case of clay tile.

The trend of agriculture in Porto Rico is toward intensive culture, and as a result the station is looked to for information along many lines. During the past year a number of planters spent several weeks at the station studying improved methods of agricultural practice. The increased correspondence, station visitors, requests for publications, etc., all indicate that the station is growing in the appreciation of the people of Porto Rico. The cooperative work with planters and orchardists is being extended in many parts of the island, and this makes it possible to include experiments on various types of soil, climatic conditions, etc., at very little expense to the station.

In the act of the Congress making appropriations for the station for the fiscal year special provisions were made for coffee investigations. The lease on the land under experiment on the coffee estate La Carmelita was about to expire, and it was canceled and, as mentioned above, the work was moved nearer the station, where a 95-acre coffee plantation has been placed at the disposal of the station for experiments in renovating an old plantation, studies on coffee diseases, insect pests, coffee improvement, etc. The introduction of the higher-priced coffees into Porto Rican culture has been continued, and some of the Java varieties are coming into bearing. Some 3-year-old trees have borne at the rate of 800 pounds merchantable coffee per acre, while the average of the island is only about 200 pounds per acre. Among the introduced varieties now in bearing are: Ceylon hybrid; Mocha hybrid; Blue Mountain, of Jamaica; Pedang, of Sumatra; Preanger, Pantgoer, Erecta, and Columnaris, of Java; Guadeloupe; Maragogype; Surinam; and Mocha. A number of others should bear their first crop next season. Experiments are in progress in transplanting coffee trees, studies on the vitality of coffee seeds, the

most economical and effective means of improving the productivity of coffee plantations, diseases and insect pests, etc. Among the diseases, a root disease, a leaf spot, and a spotting of the fruit have received most attention. A trial of various adhesives to be added to Bordeaux mixture to prevent its being washed off the foliage by the torrential rains is in progress.

A number of coffee diseases of minor importance are being investigated, as are some of the fungus and other troubles of cacao, coconuts, and bananas. A bud rot of coconut trees has been found at various places on the island, and while it destroys some trees each year, yet the total loss appears small. Bacteria have been isolated from the innermost dead tissues, but there has been a pronounced lack of uniformity in the results of studies thus far carried on. The diseases of citrus fruits have been taken up for study, especial attention at this time being given to gummosis. It is expected that cooperative work on orange scab and end rot of the fruit will also be begun soon. The pathologist has made a study of the nodules on the roots of the royal palm in the hope of elucidating some facts regarding their origin and function.

The station is actively engaged in interesting the people of the island in apiculture. Demonstration classes in the handling of bees were held at the station and they were well attended. Many of those in attendance have purchased bees and are starting apiaries. This industry appears to be increasing, and in connection with the growing of citrus fruits and on coffee plantations the keeping of bees should prove profitable, not only on account of the honey produced, but also by reason of the greater fertilization of the flowers by the bee visitors. Attention is still given to the insects affecting citrus fruits, although less injury is reported than formerly. This is due to the practice of establishing windbreaks about the orchards, thus providing conditions for the development of beneficial fungi, and to the use of sulphur sprays, which protect fruit against rust mites. A number of pests of the mango have been investigated with a view to discovering methods for their control. Studies were also made of the coffee ant, insect pests of guavas, and mosquito breeding. Contrary to the common belief, the entomologist found that mosquitoes did not breed in the mangrove swamps about San Juan.

The horticultural work has been considerably extended, particular attention being given to stocks, fertilizers, and cover crops for citrus fruits. This work has been in progress since 1906, and it is hoped to report on the work with fertilizers in the near future. Attention is being given to varieties of citrus fruits adapted to Porto Rico. Great variation has been noted in productivity, character of fruit, etc., and data are being collected to determine the causes of this wide variation. The station is conducting experiments on the introduc-

tion and propagation of the better varieties of mangoes, more than 40 varieties having been introduced from various tropical countries. Of these, 12 fruited this year, and the station should soon be in a position to tell which varieties are best suited to Porto Rican conditions. The pineapple industry is developing rapidly, and since the bulletin on pineapples was issued in 1909 the question of shade and leguminous cover crops has been given definite consideration. Variety tests of pineapples are being made, and the station has 27 varieties under observation. Experiments have been begun on the fumigation of pineapple slips before planting to rid them of mealy bugs. The results thus far do not appear to warrant the practice unless measures are taken to keep the plants clean after they have been set in the field.

The banana plantation has been moved to more suitable ground, and of the large number of varieties, 25 have been selected for further study. It is already apparent that there was a large duplication of varieties received under different names. The reduction of these duplicates will prove of value to future investigators.

Work is under way on the improvement of those crops of the island that are known to the mass of the people. These include yams, yautias, sweet potatoes, pigeon peas, beans, etc. A collection of 25 varieties of yams has been made and they are being tested for yield, quality, etc. Two varieties, Potato and Guinea, appear most promising for cultivation in Porto Rico, as they yield heavily and possess desirable culinary qualities. The work with vegetables is being continued to determine the causes of rapid deterioration in quality. Some attention is being given to ornamental trees and shrubs, and hardwood and nut-bearing trees. Thousands of trees have been distributed through schools and planters, and the work seems to be rapidly gaining in appreciation.

The chemical department has made decided progress during the year. A large amount of analytical work was completed and a number of important lines of investigations were continued. These include studies on soil disinfection, the availability of nitrogen and phosphoric acid in the native bat guanos, the effect of strongly calcareous soils on the growth and composition of plants, the action of lime in inducing chlorosis of plants, and the effect of various ratios of lime and magnesia on the growth of plants. The results obtained in the disinfection of soils which have become unproductive through the presence of organisms of various kinds indicate that a wider range of experiments is necessary before definite conclusions can be drawn. The study of the cause of chlorosis in pineapples has been concluded and the results have been published. It was found that the condition for chlorosis was too much carbonate of lime in the soil. Two or more per cent of calcium carbonate in soils was found

detrimental to pineapple growing, and a survey of soils is recommended before planting to this crop. New problems have been taken up during the past year, the most important of which are the best treatment of the red clay soils of the island and a cooperative study of chlorosis in sugar cane.

The work in animal husbandry has been considerably broadened, and it now includes horse breeding to improve the size and conformation of the horse, breeding for work oxen, breeding of dairy cattle, as well as the introduction and breeding of hogs, sheep, and poultry. The surplus stock is sold to planters, and the demand is always in excess of the supply. The investigations on the mineral nutrition of pigs, begun last year, have been concluded, and the results indicate that calcium chlorid can profitably be used with rations deficient in lime. The work with poultry is very gratifying. A large number of fowls and settings of eggs were disposed of during the year, and pure-bred poultry or crosses of the introduced breeds are to be found in nearly every community. Some work in dairying has been begun, the object of which is the more sanitary handling of milk.

Some preliminary investigations in the production of forage crops have been begun, and a variety of sorghum introduced from Barbados has given heavy yields on dry, hilly lands. The work in making and feeding silage has been continued, and it appears that the production of good silage offers fewer obstacles than in a temperate climate.

During the past year an association of the sugar planters of the island established an experiment station, placing a tonnage tax on their product for its maintenance. This station will study the peculiar problems relative to the production and manufacture of sugar, and the Federal station will be relieved of much work it had been impelled to carry on with this crop. Some cane breeding and a few cooperative experiments that were begun some years ago will be concluded, but otherwise investigations on this crop will be discontinued.

The efforts of the station to secure diversification are meeting with success, and intensive farming is assuming its proper place in the agriculture of Porto Rico.

GUAM STATION.

Much work has been done at the Guam station in the construction of new buildings, building roads, clearing and draining lands, etc. The new office building was completed and occupied in the fall of 1910, and the use of the rented quarters was discontinued. A storehouse in which to keep the farm implements was completed during the year, as was a stock barn 30 by 40 feet in extent. This gives ample space for 12 head of stock, with the necessary feed and storage room for a large amount of hay or other forage. The road system

has been extended by the construction of about 1,000 feet of cascajo road, and walks have been made about the new office building. A lawn of Bermuda grass has been established, and ornamental and hedge plants set out. These are kept clean and in order as examples of neatness and cleanliness, which are generally lacking about the native home. Upon the occupancy of the new quarters it was possible to inaugurate a system of records that a lack of suitable office space had made impossible. Considerable additions were made to the office equipment, and the beginning has been made of a station library.

The field operations with all crops were more successful than during the previous year, due probably to the improved condition of the soil which followed a year's proper cultivation. The leading investigation continues to be the production of feed and forage preliminary to experiments on the improvement of the live stock of the island, and includes experiments with corn, various grasses, and leguminous forage plants.

The experiments with corn during the year were to test the Mexican June corn from Manila in comparison with the native corn. The yield of the Mexican June corn was heavier, the ears were filled better, and the grain deeper and less flinty than the native varieties, but in an experiment on keeping seed corn under identical conditions the samples of Mexican June lost all ability to germinate, while a perfect stand of native corn was obtained. These experiments are to be continued and extended so as to include varieties of corn from practically all tropical countries.

The experiments with the grasses have shown the superior value of Para grass, followed by *Paspalum dilatatum* and Guinea grass, over all others tried. The Para grass, which was introduced through the Hawaii Experiment Station, has multiplied until the station now has an acre planted, which is to be extended, and has distributed a large number of clumps of roots for planting.

The production of forage from several of the nonsaccharine sorghums has been fully demonstrated. Of the leguminous plants under observation the pigeon pea, jack bean, and common peanut have given promise of success.

Much work has been carried on with vegetables. For some, additional data regarding the proper planting season must be secured. Beets planted in March have done well. Patolas (*Luffa aegyptica*), a vegetable usually cooked with meat or in soup, has been introduced from Manila and has proved very satisfactory. This vegetable was formerly grown in Guam, but the stock had apparently been exhausted. Limited quantities of seed of this vegetable have been distributed during the year. Radishes, especially a variety grown by the Chinese gardeners about Manila, have given excellent

results. Carrots were tested and gave full satisfaction. Onion seed planted in December failed to germinate. Where sets were received from the United States and planted, fairly good bulbs were produced. Watermelons have given excellent results, but muskmelons failed to ripen well and were lacking in flavor. Cucumbers, lettuce, and eggplants gave good yields of excellent quality. Less success has been attained with cabbage and tomatoes, but further trials are in progress.

One of the most striking achievements is in the introduction of the Smooth Cayenne pineapple from Hawaii. The plants have fruited, are of excellent quality, and many fruits weighed as much as 10 pounds, as compared with a maximum weight of 4 pounds for the native fruit. There is much interest in this fruit, and the station will distribute 1,000 or more plants this year. A number of other varieties of pineapples have been introduced for trial at the station. The results with avocados, oranges, lemons, and pomelos have been satisfactory, the trees making good growth, but all are too young to bear fruit. An attempt is being made to introduce Japanese persimmons, and trees of 10 varieties have been secured for trial in different parts of the island. Peen-to peaches, several varieties of grapes, strawberries, some Philippine varieties of bananas, and many other fruits have been introduced and are being given a trial.

Miscellaneous plants, such as Ceara rubber, kola nut, camphor, hedge plants, and some ornamentals are being tested. A Ceara rubber tree attained a height of 16 feet and a circumference of 10 inches 3 feet from the ground in a year from the planting of the seed.

Mention has been made in previous reports of the desirability of taking up experiments on the improvement of the live stock of the island. All stock is very much degenerated, owing to various causes. The horses are small and weak, likewise the cattle. A number of head of cattle were slaughtered for beef last year, and animals ranging from 20 months to 2½ years dressed 125½ to 358 pounds. The practicability of producing forage in sufficient quantity for stock having been demonstrated, experiments looking toward the improvement of the live stock of the island have been begun. There were purchased for the station 6 head of Morgan horses, 4 of Ayrshire cattle, 4 Berkshire hogs, and 8 each of Barred Plymouth Rock and Brown Leghorn chickens. Before shipment was made one of the cows dropped a fine male calf. All the stock was sent to Guam on the Army transport *Dix*, which sailed from Seattle September 15, 1911. The animals were safely landed in Guam about a month later, and, with one exception, all are reported in flourishing condition. The oldest bull died about two months after landing with

symptoms resembling tick fever. Ticks abound on the island, but they were not known to be infected, as they probably are. The other cattle showed some rise in temperature, but have apparently recovered, as no further loss has been reported. This stock has been fed almost exclusively on station-grown forage and grain, proving the possibilities of the island in this respect. If this preliminary introduction proves successful, other breeding animals will be introduced into Guam as opportunity offers.

A growing interest in the work of the station is noted, and all requests for seeds and plants have been granted as far as supplies were available, and instructions given regarding their planting and care, every encouragement being offered to increase interest and bring success to the planter. The cordial cooperation of the local authorities in furthering the station's work has aided materially in the attempt being made to improve the agricultural condition of the island.

NUTRITION INVESTIGATIONS.

The nutrition investigations of the Office of Experiment Stations have to do with the value of agricultural products, both animal and vegetable, used as food, and the work has been continued along a number of lines.

Studies have been made with the respiration calorimeter of the relative ease of digestion of cheese (American Cheddar) and meat (beef) when used in ordinary amounts as part of a mixed diet. The results do not indicate that marked differences exist in the ease of digestion of these foodstuffs under such conditions. Many tests have been carried on also with respect to methods of preparing cheese for the table.

On the basis of this and earlier work with cheese, an article on this foodstuff and other possible substitutes for meat was prepared for the Yearbook of the department for 1910, and also a Farmers' Bulletin on Cheese and its Economical Uses in the Diet, which considers the ways in which cheese may be used in quantity as a palatable, wholesome, and nutritious part of the daily food. Material has also been accumulated for use in a technical bulletin on the digestibility and nutritive value of different sorts of cheese, which brings together results of extended series of experiments, including those carried on in cooperation with the Bureau of Animal Industry, which have been summarized in a circular of that bureau.

Numerous improvements have been made in method and equipment in the respiration calorimeter laboratory. Very important accessory apparatus has been installed which greatly facilitates the heat measurements in experiments with the respiration calorimeter and gives an automatic and continuous record of the heat output which

insures accuracy as well as economy of operation. The new apparatus includes a device for the automatic control, as it enters the respiration chamber, of the water current which carries out the heat liberated in the chamber and a device for securing automatically a continuous record of the temperature, as it leaves the chamber, of this water current; in other words, the measurements of the energy output of the subject are made automatically and continuously with an accuracy which could not be reached hitherto. At the same time the labor of conducting the experiments has been greatly lessened, a matter of much importance in experiments which continue uninterruptedly for a number of days at a time. Some of the improvements in the respiration calorimeter have been noted in the description of it in its present form, which appeared in the Yearbook of the department for 1910.

During the past year a new line of investigations has been undertaken with the respiration calorimeter, which marks a departure in studies of this kind and indicates a broader application of the experimental method. These newer experiments have to do with problems connected with the ripening of fruit and have shown that the apparatus is applicable to such studies. Several bunches of bananas were placed in the respiration chamber and kept under observation during the active ripening process, which was completed to the usual commercial stage. During this time the oxygen consumption, the carbon dioxid excretion, and the heat elimination were determined. The data obtained indicate that physical and chemical factors of great value in the study of this problem, which is of both practical and theoretical importance, can be accurately measured with the respiration calorimeter.

It has been found very desirable to employ a smaller respiration chamber for such work, since it involves the handling of smaller quantities of fruit and a better control of experimental conditions. Consequently, a respiration calorimeter more suited in size to these particular investigations has been constructed in which the respiration chamber is 18 by 18 by 36 inches in size. Recording and controlling devices of special construction involving much that is new and original have been used in this apparatus to such an extent that the calorimeter will be very largely automatic in operation and can be operated at the same time and by the same observers as are employed upon the other calorimeter in experiments with man.

The work thus far done with ripening fruits was undertaken in cooperation with the Bureau of Chemistry of this department, and it marks the adaptation of the respiration calorimeter to a wider range of investigation along lines in which it has not hitherto been employed and in which investigations have not been numerous owing to a lack of adequate methods. It has demonstrated that the instrument is fully

as well suited for the study of certain fundamental problems of plant life as it is for the study of similar problems of animal life. Plans are already under consideration for experiments on a variety of such problems, with the object of securing data needed in projects which the Department of Agriculture has under investigation.

The apparatus can be used in similar ways in studying such problems as the changes which take place when meat or cheese or other farm products are cured or ripened and factors which influence these changes—problems which are of commercial interest as well as of agricultural, domestic, and scientific importance.

The small respiration calorimeter has been so constructed that with a little modification of the metal-walled respiration chamber it can be used for experiments with small animals as subjects should cooperative work between bureaus of the department make this desirable. As is the case in the respiration-calorimeter experiments with men as subjects, ample provision can be made for the comfort of the animals in such experiments, in order that the results may be normal.

It would be particularly useful to study by these or similar methods the influence of heat and of the moisture and carbon-dioxid effect of the air upon eggs during incubation by a hen and by artificial methods, and also to study in detail the respiratory and energy changes of incubating eggs.

This new calorimeter work has been spoken of in recent publications.¹

A micro-calorimeter for use in the experimental study of very small quantities is being installed. With it some of the details of fruit-ripening problems now under investigation can be advantageously studied as well as other questions. This piece of apparatus materially extends the possibilities of studying agricultural problems by calorimetric methods, but involves little that is new in the way of equipment since the recording and controlling devices already in use with the larger calorimeters serve for this kind of work also.

During the fiscal year a technical bulletin, entitled "Calcium, Magnesium, and Phosphorus in Food and Nutrition," has been published, as well as a series of 15 colored food and diet charts. A Farmers' Bulletin on the care of milk and its use in the home has been issued in cooperation with the Bureau of Animal Industry. A circular on food customs and diet in American homes has been published, as well as two articles already referred to, which have appeared in the Yearbook of the department, and numerous summaries, which have appeared in annual reports and similar publications. There has also

¹ Experiment Station Record, 24 (1911), pp. 601-606; U. S. Dept. Agr., Office Expt. Stas. Circ. 116.

been prepared for publication during the fiscal year a technical bulletin and two popular bulletins.

The work of collecting and editing data on food and nutrition topics has been continued, as has also the preparation of material for publication in the Experiment Station Record and in the subseries of Farmers' Bulletins entitled Experiment Station Work. An increasingly large amount of time is required for providing data on nutrition and related topics, requested by housewives, teachers, and other correspondents.

During the year 1912 it is proposed to continue the work with cheese and meat already in hand, in so far as this seems necessary, and to undertake studies with the respiration calorimeter, in cooperation with the Bureau of Animal Industry, of the nutritive value of table and culinary fats, supplementing this work by special studies of the use of different fats in preparing foods for the table and of the general use in the diet of this important group of foodstuffs. Plans have also been made for extended studies of the gaseous exchange and energy transformations of fruits and vegetables during the ripening period, this work to be carried on in cooperation with other bureaus of the department. Such work will be greatly facilitated by the use of the small respiration calorimeter which has been constructed.

For the year 1913 plans have been formulated which involve additional cooperative studies with the respiration calorimeter of problems concerned with fruits and vegetables during ripening and storage, and other physiological studies of plant growth, as well as studies of the changes which take place in animal food products—for instance, butter, eggs, and cured meats during different conditions of storage. It is also proposed to supplement the technical work by studies of problems of household interest and to continue the preparation of popular bulletins and other publications to meet the demands which are made for them.

IRRIGATION INVESTIGATIONS.

The increased appropriation granted by Congress for the irrigation investigations of this office has made it possible to broaden the scope of the work and to place agents in several States where they have been needed for some time. The work has been continued along the same general lines outlined in my report for 1910, and is still under the direction of Samuel Fortier, chief. The most important changes and extensions in the work are noted in the following paragraphs:

CALIFORNIA.

Agreements have been entered into between the Department of Agriculture and the conservation commission created by the 1911

session of the California Legislature, whereby the commission has agreed to set aside \$17,500 to be expended under the supervision of this office in preparing an irrigation map and ascertaining the following facts: The water supply, both surface and underground, available for irrigation; the extent, character, and location of agricultural lands susceptible of irrigation; the present extent of irrigation; and the extent and location of unused waters.

COLORADO.

The Colorado Agricultural Experiment Station is now expending \$5,800 in cooperating with this office in conducting experiments pertaining to the construction of weirs and concrete structures, irrigation by pumping, coefficients of friction in ditches, and the irrigation and drainage requirements of different crops. V. M. Cone is in charge of this work.

KANSAS.

The legislature of this State in its 1911 session appropriated \$2,000 per annum for two years to cooperate with this office in determining the water requirements of the Kansas crops, the proper time to irrigate, the possibilities of using small water supplies in the short-grass country, and the methods and cost of irrigating from wells. Experiments along these lines are being carried on with water pumped from a well on the farm of the Garden City substation of the Kansas State Experiment Station.

MONTANA.

S. T. Harding was placed in charge of the work in this State at the beginning of the irrigation season of 1911. The season just past has been largely spent in collecting data for the preparation of a bulletin on irrigation in Montana. Henceforth he will spend the greater part of his time in collecting data as to the methods and practices in use in the State and in advising and assisting settlers in adopting better methods.

NEBRASKA.

F. W. Stanley was assigned to this State in June, 1911, and has collected data and prepared a bulletin on irrigation in the State. An agent will be maintained in the State during the coming year.

NEVADA.

Investigations to determine the seepage from and the waters returning to Humboldt River, the evaporation losses from irrigated lands, and the effect of different amounts of water on the quantity and quality of the yields of crops are being carried on in this State in cooperation with the Nevada Agricultural Experiment Station and the State engineer. F. L. Peterson has charge of this work.

OREGON.

H. W. Grunsky assumed charge of the work in this State at the beginning of the fiscal year and has collected data and is preparing a bulletin on irrigation in the State. Most of his time in the future will be spent in collecting data in regard to irrigation methods and practices and rendering advice and assistance to settlers, as is being done in the other States.

WYOMING.

Fred C. Scobey, located at Cheyenne, now has charge of the work in this State. The same lines of work will be continued at the demonstration farms at Cheyenne and Newcastle as heretofore. He will also spend a large part of his time in going about from place to place in sections where new lands are being brought under irrigation, with the purpose of demonstrating to new settlers the better methods of preparing land and applying water. During the past year data were collected regarding the irrigation development in the State under the Carey Act and irrigation district law.

COOPERATION WITH THE BUREAU OF THE CENSUS.

During the past year and a half this office has cooperated with the Bureau of the Census in taking an irrigation census of the United States. Tabulation of the data obtained has been completed in part by the Bureau of the Census and some of the results published. These results bring out clearly three great needs for work such as comes within the field of this office, namely: (1) The collection of data and publishing of bulletins intended to give the information desired by persons contemplating settling in the irrigated sections and to assist both the new and old settlers in solving the many problems which arise in irrigating their lands; (2) investigations and experiments pertaining to the water requirements of crops, prevention of losses, and other subjects affecting the duty of water; (3) a careful study of the organization and management of irrigation enterprises.

Construction has far outrun settlement in the irrigated sections during the past 10 years, and the greatest need of the irrigated West to-day is settlers rather than the starting of new projects. The enterprises now completed or under way are ample to satisfy the demand for lands during the next decade or more. The area irrigated increased from 7,527,700 acres in 1899 to 13,739,500 acres in 1909. This increase in itself is remarkable and may be attributed in part to the prominence given irrigation by newspapers, magazines, lecturers, and real-estate agents. However, even with this rapid increase, the enterprises reported that by July 1, 1910, they would be able to supply water to an additional 5,596,000 acres, and

there were 11,776,000 acres more included in the projects under way. A considerable amount, perhaps 20 per cent, of these last items can never be profitably irrigated, being too rough, too high, or alkaliied and other waste spots, but, making allowance for such lands and for lands which were settled but not irrigated in 1909, and assuming that the enterprises now under way will be the only ones undertaken, settlers will be needed for an area as great as that reclaimed by irrigation in the last 50 years. The Reclamation Service which has charge of the construction of the Government irrigation works finds itself confronted with the same problem of securing settlers rapidly enough. Director Newell, of that bureau, stated on February, 1912, in the hearing before the House Committee on the Irrigation of Arid Land, that the estimated total area for completed Government projects was 2,937,838 acres, of which amount 711,124 acres were irrigated in 1911, and the service would be prepared to supply water to 1,113,766 acres in 1912.

AID TO SETTLERS.

This need of settlers gives rise to very urgent demands for two kinds of information: First, conservative, unbiased information concerning the conditions and possibilities of the several sections, together with the cost of obtaining lands and water and preparing and bringing the land under cultivation, etc.; and, second, information to assist new, as well as old, settlers in adopting the best methods of preparing land and distributing and applying the water. The irrigated lands of the West must be peopled almost entirely from the farming regions of the Mississippi Valley and the cities of the Eastern and North Central States. While many of these may have farmed in humid regions, very few know anything of irrigation farming, and a considerable number have had no agricultural experience whatever. Many of them also are staking the savings of years upon this venture, with little to guide them except the glowing advertisements of real-estate men, chambers of commerce, immigration commissioners, and others interested in the disposal of lands or the settlement of certain sections or States. The success of these settlers and the prosperity of the communities will depend largely upon the newcomers getting properly located, knowing in advance the problems and difficulties they must encounter, and in being properly started in their new work.

This office is meeting both of these needs, the first by the series of bulletins upon irrigation in the several States, and the second by the bulletins upon the irrigation of different crops and by placing in each State one or more agents who teach the settlers the best methods of preparing the land and applying water, by traveling

about collecting data, delivering talks at gatherings of farmers, and visiting the irrigators personally.

USE OF WATER.

of the irrigated area is also giving rise to a regard to the water supply. Up to a few years ing next to the streams, and therefore easily were settled, and the water supply was far ands made upon it. To-day more distant and are being taken up, more costly works are nec sections more than the maximum water supply ole years is filed on. The census returns show rks has increased from an average of \$8.89 per 99 to an average of \$15.76 per acre for the acreage e prepared to supply water to in 1910.

Further, except in a few cases, will be possible only by the construction of still more costly diversion and storage works, or by the installation of pumping plants. In but few sections of the arid and semiarid region is the water supply ample to reclaim more than a small part of the arable lands and the area that will ultimately be irrigated is limited only by the possibility of getting water and the cost of obtaining it. Thousands of acres can never be reclaimed until the duty of water upon lands already under irrigation has been raised by reducing the losses due to seepage and evaporation in bringing the water to the land and applying it, by devising and introducing better and more economical methods of distribution and application, and by preventing the wasting of water so commonly practiced by irrigators in order to hold the entire amount granted by State statutes passed when water was plentiful, settlers few, and methods crude. Even to-day thousands of acres are being water logged and alkali-laded and crop yields reduced by the use of too much water, while adjoining lands of equal, or even greater, fertility can be used only for range, owing to the lack of water.

A higher duty of water will also enable a much larger area to be settled, for if larger tracts can be irrigated from the same works, per acre costs of construction will be reduced and kept from becoming exorbitant, as they are now tending to do.

Four things, besides the hearty cooperation of the irrigators, will be necessary in bringing about a higher duty of water and the extension of the area irrigated:

- (1) The flood and out-of-season flow of streams must be conserved by storage and winter irrigations.
- (2) The best methods of distributing and applying water in the several irrigated regions must be studied and modifications worked

out in order to improve them or better adapt them to the different conditions in other localities. These methods, or their modifications, must then be introduced by means of bulletins describing them and by demonstrations carried on under the supervision of men who know both the scientific and the practical sides of irrigation. The methods in general use in most localities are largely a blind imitation of those used by the earliest settlers, and in many cases are poorly adapted to the changes in crops grown and the amount of water available for irrigation. Many localities, however, have devised one or more highly developed methods as the result of the experimentation of one or two men. In many cases, however, these methods are very local in their use, and their introduction into other sections will be exceedingly slow if left entirely to the settlers themselves.

(3) Although the demand for engineers for the designing and construction of works will probably not be so great as in the past, another and a broader field now opens for engineering ability. Economy in the conveyance and distribution of water is necessitating the replacement of old wooden structures with concrete ones; the substitution of flumes, lined ditches, and underground pipe lines for unlined ditches; the installation of weirs and measuring devices; the use of pumping plants; and the more careful laying out, leveling, and preparation of fields. Companies are coming to see more and more the need for a class of engineers who are well versed in agriculture and irrigation management, as well as in location and construction.

(4) State legislation must be enacted that will favor duty of water investigations and encourage, if not render compulsory, a more economical use of water for irrigation purposes. Under most, if not all, existing laws, the irrigator who prepares his land carelessly and uses the cruder methods of irrigation, and the one who uses more water than he knows is best merely that he may keep his full appropriation for an abnormally dry year, retain their appropriation, while the irrigator who, because of the careful preparation of his lands, the use of the most improved methods of application, and thorough cultivation, is able to raise as good or better crops with a less amount of water, is not permitted to reap any reward for his extra cost and labor, but must return the surplus water to the stream for the use of others. Under such conditions the progressive irrigator is not anxious to cooperate with this or any other office in conducting experiments that will furnish evidence that 1 cubic foot per second per 100 acres constitutes beneficial use on his lands, while such experiments can not be used as evidence against his neighbor who uses 1 cubic foot on only 70 acres of similar land.

MANAGEMENT OF IRRIGATION ENTERPRISES.

One of the most noteworthy facts brought out by the census returns is the large percentage of the area under irrigation that is under systems managed by the irrigators themselves, and the great area in enterprises under way that is or will eventually come under such organizations. The following table shows the acreage and the percentage included in each type of organization:

Acreage and percentage of lands irrigated in 1909 and included in enterprises under way, divided according to type of organization.

Type of enterprise.	Irrigated in 1909.		Included in enterprises under way.	
	Acres.	Per cent.	Acres.	Per cent.
Individual and partnership.....	6,258,401	45.5	10,154,153	32.7
Cooperative.....	4,646,039	33.8	8,845,437	28.5
Commercial.....	1,444,806	10.6	5,096,337	16.3
Irrigation districts.....	533,142	3.9	1,589,865	5.1
Carey Act.....	288,553	2.1	2,573,874	8.3
United States Reclamation Service.....	395,646	2.9	1,973,016	6.3
United States Indian Service.....	172,912	1.2	879,068	2.8
Total.....	13,739,499	100.0	31,112,100	100.0

Nearly 11,438,000 acres, or over 84 per cent of the total acreage irrigated in 1909, was in individual, partnership, or cooperative enterprises or irrigation districts, the management of all of which is in the hands of the irrigators themselves. When the enterprises of these types now under way are completed, and the Carey Act and Reclamation Service projects settled and the management turned over to the settlers, more than 25,000,000 acres, or 81 per cent of the lands then irrigated, will be in enterprises managed by the irrigators. Moreover, judging by the trend of the past 15 years, a considerable part of the systems now constructed or being constructed by commercial companies will pass into the hands of the irrigators, and it is safe to say that eventually 85 per cent of all the lands irrigated will be in enterprises managed by the irrigators themselves.

Many changes in the organization of the enterprises already managed by the irrigators will also take place. Reorganizations will be necessary to meet new conditions, necessary extensions, etc.; consolidation of private, partnership, and small cooperative ditches must needs follow the increase in the value of water in many sections; some of the large cooperative companies will find the district form of organization advantageous; and in some cases the Carey Act organizations will be changed to irrigation districts soon after the settlers obtain unencumbered title to their lands and the management has been turned over to them by the constructing companies.

The irrigators are thus brought face to face with all the varied and complicated problems of organizing, financing, constructing, operat-

ing, and maintaining a canal system; and the need for advice and assistance along all these lines is urgent, especially in those sections which have been settled up rapidly by people, most of whom are without experience in irrigating or irrigation management. The demands upon this office for information along these lines are rapidly increasing in number, and it is the intention of the office to devote considerable time during the next few years to a study of such features of canal management as organization of enterprises, extensions, betterment, measurement and delivery of water, operation, maintenance, water charges, and revenues and expenditures.

~~DRAINAGE INVESTIGATIONS.~~

During the year a plan hitherto applied only to those members of the staff engaged in the investigation of the drainage of irrigated land was extended to include the entire field force. This consisted in assigning each of the field engineers to permanent headquarters. These headquarters are well distributed over those parts of the country in which the drainage investigations of the office are mainly centered, and were selected with regard to their availability as bases for operations. This arrangement not only effects a considerable saving in the time and expense incident to traveling, but enables each representative to become acquainted with the peculiar needs of his territory and to keep in touch with the local drainage situation; the office is thus enabled to render more efficient and economical service.

The expansion of the work of drainage investigations, due to the general increase of interest in the subject of land drainage, necessitated an increase during the year in the staff of office engineers and draftsmen. The members of the staff of some 25 field engineers were constantly engaged in giving advice on concrete drainage problems within their territories, in the collection of technical data useful to engineers and others in planning the drainage of lands, in making preliminary examinations and reports on prospective drainage undertakings, or in carrying on detailed drainage surveys, formulating plans, and making reports upon those projects in which the office deemed it advisable to participate to that extent. The field representatives of the office also assisted in the organization of drainage districts, and rendered aid in the formulation of efficient State drainage laws such as are necessary before drainage undertakings can be carried out.

The main lines of work carried on were the same as in former years, viz: (1) Improvement of farm lands now under cultivation; (2) the drainage of swamp and marsh lands; (3) the reclamation of land subject to damage by overflow of streams; (4) the drainage of irrigated lands; (5) general technical investigations; and (6) the dissemination of information relating to drainage. The improvement of

farm land consists mainly in designing tile-drainage systems and outlet ditches and in supervising their construction. The classification swamp and marsh lands includes those areas which are permanently or periodically too wet for cultivation, due either to entire lack of outlet, to inefficiency of outlet, or to tidal encroachment. In this class are the tidal marshes along the Atlantic and Gulf coasts, and by far the greater part of the enormous undeveloped swamp areas of the Southern States. The reclamation of overflowed land presents intricate problems calling for the highest engineering judgment to determine the maximum rate of run-off, the economical sizes of channels, the proper location and dimensions of levees, and the best arrangement for the interior drainage system. The continued irrigation of lands in the arid region has resulted in the injury of a very considerable part of those lands by seepage water and the concentration of alkali on or near the ground surface. The drainage problems are peculiar to the irrigated region, their solution requiring special study and no little experience in interpreting the effect of subsurface conditions upon the movement of the ground water.

The collection of technical data relating to drainage is an important part of the work of drainage investigations. A knowledge of the relation of run-off to rainfall, topography, and vegetation is of basic importance in the design of adequate and economical drainage works, yet very few data on this subject are at present available. Considerable work has been done along this line during the year.

Investigations have also been made of the special problems of pumping for drainage and of tidal marsh reclamation, and some experiments have been made to determine the practicability of using explosives in the construction of ditches.

C. G. Elliott was in charge of drainage investigations, and all work was done under his direction.

IMPROVEMENT OF FARM LANDS.

O. G. Baxter made a survey and plans for drainage on the Arkansas State Penitentiary farm in Lincoln County, Ark. The entire farm was surveyed, but detailed plans were prepared for underdraining only a 32-acre experimental tract.

Plans were made by J. R. Haswell for the tile drainage of a portion of the farm owned by Judge Max L. McRae, in Telfair County, Ga. The farm consists of about 1,400 acres, of which 375 acres are in cultivation.

On the farm of the Bureau of Animal Industry, United States Department of Agriculture, near Beltsville, Md., S. H. McCrory surveyed a poorly drained area and laid out a system of underdrains. Plans were made for laying about 10,000 feet of tile to drain about 50 acres.

C. W. Okey made a survey of a part of the farm of Dr. L. S. Rogers, near West, Miss., which is situated in the bottoms of the Big Black River, and planned the necessary tile drainage for about 200 acres of wet land.

Walnut Grove plantation is located in Coahoma County, Miss., near the Mississippi River. The plantation has well-defined natural drainage channels, but requires the use of tile to maintain efficient drainage. Plans were prepared by S. H. McCrory for the part of the land most difficult to reclaim. The drainage of this plantation has been under way for two or three years.

At the request of Prof. B. W. Kilgore, director of the North Carolina Experiment Station, the office made examinations and surveys of three of the test farms of the State, these being known as the Willard, Rocky Mount, and Elmwood. Portions of all of these farms were surveyed by J. R. Haswell, and plans furnished by him for providing efficient drainage.

James Island, S. C., lies directly opposite the city of Charleston. The island has a total area of about 20,000 acres, and it is intersected by numerous small tidal streams extending into the interior. Its general elevation is but a few feet above mean low water and tidal action greatly interferes with the natural drainage. Climatic conditions there are so favorable that when properly protected and drained the land yields large returns. George M. Warren made a survey including about 10,600 acres of the most favorably situated land and submitted plans for its protection from tidal encroachment and for its drainage.

J. R. Haswell surveyed and made plans for the drainage of a portion of the property of Dr. Albert Shaw, known as the Sterling Farm, in Loudoun County, Va. The total area of the farm is 1,600 acres, mostly hill land. There the problem of drainage was to protect the flat area from the drainage water coming from the hills.

The Bureau of Plant Industry of the Department of Agriculture conducts an experimental farm at Arlington, Va. Certain parts of this farm require artificial drainage, considerable tile having been laid in years past. A survey of the farm was made by H. A. Kipp, who laid out plans for the installation of about 36,000 additional feet of tile.

DRAINAGE OF SWAMP LANDS.

In southeastern Arkansas, between Bayou Bartholomew and Crooked Bayou in the counties of Chicot, Drew, and Desha, are some 26,000 acres of land at present practically useless for agricultural purposes owing to lack of drainage outlet; following a wet season the water remains over the area for months. O. G. Baxter made a survey of this tract and prepared plans for the necessary drainage channels to remove the surplus water.

J. R. Haswell formulated plans for improving McRae Branch, Telfair County, Ga. This branch is the main outlet for the drainage of the flat lands in the vicinity, and its improvement, together with the construction of necessary laterals, is essential as a preliminary step to the complete drainage of the adjoining 1,650 acres of "flat woods."

The Belzoni Drainage District lies in the eastern part of Washington County, Miss. An extensive survey was made under the supervision of H. A. Kipp, who worked out plans for the reclamation of 90,000 acres in this district. The report on that project has been issued in printed form.¹ The drainage conditions in that district and the corrective methods to be pursued are representative of many similar areas in the Yazoo Delta which, though having rich alluvial soil, are not available for cultivation without drainage.

Lewis A. Jones surveyed and made plans for the drainage of 25,600 acres of seeped and overflowed bench land along the Elkhorn River, in Holt County, Nebr. Ninety per cent of this area is at present too wet for cultivation, being only suitable for wild hay. The damage is due partly to insufficient channel capacity above the area under consideration, but mostly to the seepage from the adjoining hill land, the latter condition being the cause of almost uniform saturation of the bench lands during the spring and early summer months.

There has been formed in Robeson County, N. C., the Back Swamp and Jacob Swamp Drainage District. The territory included in this district was surveyed under the supervision of S. H. McCrory, who prepared detailed plans and estimates for the necessary drainage improvement. The report has been published as a bulletin of the office.² The district contains 32,850 acres of wet land in which drainage conditions are due to lack of efficient outlet, it being in this respect representative of other large areas in eastern North Carolina.

The Hopkins Drainage District, in Richland County, S. C., contains some 24,000 acres which are not available for cultivation owing to poor drainage outlets. The swampy condition results in malaria to such an extent that white people are unable to reside continuously in that section. The drainage improvements formulated by J. V. Phillips, following a survey of the district, contemplate the complete drainage of 3,500 acres of rich bottom land in addition to so improving the entire health condition of the district that it may be settled by progressive people.

In Charleston County, S. C., the McClellanville Drainage District has been organized to include 4,450 acres, 1,245 of which are contained in the permanently wet Little Wambaw Swamp. This area, although naturally very fertile has poor drainage outlets, and on

¹ U. S. Dept. Agr., Office Expt. Stas. Bul. 244.

² U. S. Dept. Agr., Office Expt. Stas. Bul. 246.

that account is too wet to be cultivated except to a small extent. F. G. Eason made a survey and plan for the improvement of this district.

RECLAMATION OF OVERFLOWED LANDS.

S. H. McCrory made a survey of a portion of Little Hurricane Creek, Tuscaloosa County, Ala., and formulated plans for protecting the bottom land. Though rather narrow, these bottoms are very fertile and would be highly productive if protected from overflow. By the recommended improvements 500 acres would be protected from ordinary floods and as much more benefited to a less degree.

The West Fork of the Des Moines River in Palo Alto, Pocahontas, and Humboldt Counties, Iowa, presents a typical example of agricultural loss due to an overflowing small stream, its recurring floods having prevented cultivation of the adjoining bottoms for several years. O. G. Baxter supervised a survey of this portion of the river and made plans for protecting 14,770 acres from overflow. The report upon this project was published by the Iowa State Drainage, Waterways, and Conservation Commission in its report for 1910.

F. F. Shafer conducted a survey and made plans for the reclamation of 40,000 acres of bottom land along the Cottonwood River, in Lyon, Chase, and Marion Counties, Kans. This is a highly prosperous agricultural valley in which several thriving towns are located. The damage by overflow from this river has been enormous, the loss from this source during the past eight or nine years having been estimated at not less than \$2,000,000.

The Haw River, with its tributaries, in Rockingham and Guilford Counties, N. C., has been the cause of great agricultural loss in recent years, frequent overflows preventing successful cultivation of the adjoining lowlands. Owing to the narrowness of the bottoms, the cost of complete protection would be excessive at this time. This was determined by a survey conducted by S. H. McCrory, who made plans for the partial protection of 3,700 acres.

Surveys were made by J. V. Phillips of the Third Creek and Fourth Creek Valleys, in Iredell County, N. C. These creeks typify the poor drainage channels that exist in this section, where intermittent overflows prevent the profitable cultivation of the adjoining lowlands. The area that would be benefited by the proposed improvement of Third Creek is 1,825 acres, and by the improvement of Fourth Creek, 1,570 acres.

A survey was made by W. W. Weir of the Black Bear River and its adjoining bottom land, in Noble and Pawnee Counties, Okla. The bottom land examined amounts to 16,500 acres, which are periodically overflowed by the river, whose channel is too small and

obstructed to carry the water coming to it. The construction of the recommended improvements would result in much benefit to the valley.

Lying along the Chickahominy River in Hanover, New Kent, Henrico, and Charles City Counties, Va., is a low, wet area containing about 15,000 acres, known as the Chickahominy Swamp. Under present conditions these lowlands can not be cultivated with any assurance of success, owing principally to overflow due to the insufficient channel of the Chickahominy River. Under the supervision of George M. Warren a survey was made of this portion of the river and its adjoining bottom land, and recommendations and estimates made for increasing the capacity of the river to afford protection from ordinary floods.

DRAINAGE OF IRRIGATED LANDS.

Some especially perplexing problems in the reclamation of seeped lands have been presented in Colorado. Investigations are carried on in that State by D. G. Miller, who examined a large number of tracts in the Grand River Valley, made surveys and plans for their drainage, and superintended the execution of the work.

Drainage district No. 1, Lemhi County, Idaho, was visited by R. A. Hart, who examined in detail the plans for ridding the district of alkali and surplus water resulting from overirrigation, which had rendered the land of the district unproductive.

Investigations in New Mexico, begun by S. W. Cooper in 1910, have been carried on by him throughout the fiscal year. Assistance was given at many points in the Pecos Valley. This work consisted in the study of methods employed, the planning of drainage systems, and the superintendence of construction. Considerable work was done in the vicinity of Dexter and Roswell, and many other points were given assistance.

Drainage investigations in the irrigated section of Texas have been carried on by W. N. Hall, with headquarters at Brownsville. A large number of seeped areas of various extents have been examined and plans worked out by him for their drainage. W. A. Kelley also spent some time in the Rio Grande Valley conducting similar investigations.

Further experimental work was done in the Washington Field near St. George, Utah. Drainage systems were planned by R. A. Hart for a number of other tracts in that State, among them being the Robert Kirkman farm, the Storr Brothers' tract at American Fork, H. P. Hemingsen's farm at Riverton, and the Jensen tract at Murray. C. F. Brown and R. A. Hart worked out plans for reclaiming the Hinckley-Deseret and Oasis tracts from seepage and alkali,

which have so affected the areas that immediate action is the only alternative to complete abandonment.

W. W. Weir has continued investigations begun by J. C. Carpenter in 1910 in the Yakima Valley, Wash. More than 6,000 acres of seeped land in the Moxee Valley were studied and drainage plans worked out which have been adopted by the landowners. Also, considerable work of a consulting nature has been done in reference to a number of smaller tracts.

Investigations were made of several areas injured by seepage and alkali in the Big Horn Basin and Shoshone Valley, Wyo. The Bench Canal project, near Germania, was studied by W. A. Kelley, representing Drainage Investigations in that State, who worked out plans for reclaiming and benefiting 2,400 acres. Other tracts in the vicinities of Powell, Byron, and Lovell were visited and assistance rendered.

TECHNICAL INVESTIGATIONS.

The relation of run-off to rainfall, topography, and other factors has been studied quite extensively during the year. In making the investigations it was endeavored to select, so far as was practicable, locations typical of the varying climatic, topographic, and soil conditions with which the drainage engineer must deal. As representative of a watershed of rolling character the Forked Deer River in Jackson County, Tenn., was selected, and there J. V. Phillips made run-off investigations for several months, keeping rainfall records, making measurements of flood flow, and collecting other data. Fred F. Shafer and W. J. Schlick made similar investigations in the flat swamp land of southeast Missouri. C. W. Okey studied run-off conditions in the Yazoo Delta, Miss., and in the prairie lands of southern Louisiana. D. L. Yarnell obtained run-off data in the Boggy Bayou district near Arkansas City, Ark. The results of these investigations, thoroughly digested, will be prepared for general distribution and will, it is believed, constitute a valuable addition to the meager data now extant upon this important subject.

S. M. Woodward, after extensive study of the subject, prepared a report upon drainage by pumping.¹ Prof. Woodward made a thorough study of past experience and present practice in this method of draining, to determine the proper size, location, arrangement, construction, and management of pumping plants and methods of interior drainage, and the costs of this kind of reclamation.

The excavation of ditches by the use of dynamite was the subject of some study by J. R. Haswell, F. G. Eason, and Sidney W. Cooper, who participated in several experiments in the endeavor to determine the practicability and cost of this method of constructing ditches.

¹ U. S. Dept. Agr., Office Expt. Stas. Bul. 243.

The reclamation of tidal marshes as practiced in New England, Nova Scotia, and New Brunswick was investigated in detail and reported upon by George M. Warren.¹

A study of the effectiveness of tile drainage in the "buckshot" soils of Mississippi was carried on by C. W. Okey. Many special problems peculiar to the drainage of irrigated lands were investigated by various engineers of the office.

PRELIMINARY EXAMINATIONS AND RECONNOISSANCE.

Under this head may be classified a large part of the activities of drainage investigations. Advice is given by the engineers based upon actual field examinations, although little or no instrument work is done in such cases. A reconnoissance is always made by an engineer preliminary to an actual drainage survey undertaken by the office. Some of the more important projects covered in this way during the past year are the following:

The prairie lands of Alabama; swamp land in Effingham² and Telfair Counties, Ga.; lands overflowed by the Kootenai River, Idaho; overflowed bottom land of the Potomac River, Montgomery County, Md.; Green Harbor marsh lands, Plymouth County, Mass.; Wyacanda River, Clark County, Mo.; Beaver Dam Swamp, Flea Hill drainage district, and Selma Creek, N. C.; Sumter, Levy Bay, Wappahoola, and Dean Hall plantations, Wadmalaw Island, the lands of the Okeetee Club near Switzerland, and Great Pedee River, S. C.; Drainage District No. 1 in Norfolk County, swamp land near Newport News, and overflowed land along the Meherrin River, Va.

DISSEMINATION OF INFORMATION.

There is constant application to the office, through the mails, for information and advice on questions covering all phases of land drainage. Thus by correspondence there is given out a great deal of information, some of a general nature and some applied to the specific conditions described by the inquirers.

While most of the reports upon examinations and surveys are prepared only in typewritten form, a limited number, pertaining to projects peculiarly representative of large areas or affecting a large number of interests, are published for general distribution. The publications of the office during the year that relate to drainage of lands for agriculture are as follows: Report on the St. Francis Valley Drainage Project in Northeastern Arkansas (Office of Experiment Stations Bul. 230); A Report upon the Reclamation of the Overflowed Lands in the Marais des Cygnes Valley, Kans. (Office of Ex-

¹ U. S. Dept. Agr., Office Expt. Stas. Bul. 240.

² U. S. Dept. Agr., Office Expt. Stas. Circ. 113.

periment Stations Bul. 234); A Preliminary Report on the Drainage of the Fifth Louisiana Levee District (Office of Experiment Stations Circ. 104); The Drainage Situation in the Lower Rio Grande Valley, Tex. (Office of Experiment Stations Circ. 103).

In addition, the following reports have been printed in State bulletins: Drainage Examinations and Surveys in Georgia conducted by Drainage Investigations, Office of Experiment Stations, United States Department of Agriculture, 1908-1911 (Geological Survey of Georgia Bul. 25); Drainage in Iowa: The West Fork of the Des Moines River (Report of the Iowa State Drainage, Waterways, and Conservation Commission, 1910).

PROMOTION OF AGRICULTURAL EDUCATION.

The world-wide extent of the agricultural education movement was again apparent in 1911. Nearly every civilized country in the world now makes provision for instruction in agriculture in public educational institutions. In many instances the colleges of agriculture are departments of universities or are otherwise associated with these higher institutions of learning, and in nearly all cases where new Government universities are established provision is made for colleges of agriculture. For example, a provincial university recently provided for by the Legislature of British Columbia is to have a college of agriculture with associated schools of forestry, domestic science, and veterinary science. In our card index of foreign agricultural schools there are now over 6,500 cards, but in some cases several cards refer to the same school.

In the United States nearly every large association of educators has given a prominent place in its program to agricultural education, and several State commissions have been investigating the educational needs of agriculture and formulating plans for meeting them. One new national association of agricultural educators was formed.

The fourth session of the Graduate School of Agriculture was held at Ames, Iowa, with a larger enrollment than any previous session, and the announcement was made that the fifth session would be held in 1912 at the Michigan Agricultural College.

The attendance at the land-grant colleges and the funds available for their support were larger than in any previous year. They had 53,700 students in interior courses, and over 35 per cent of these were in agricultural courses. They also had over 169,000 students in exterior courses, not including farmers' institute gatherings addressed by college men. The additions to the equipment of these institutions were valued at over five and one-half million dollars. Among the large biennial appropriations to these colleges and universities were

\$3,600,000 to the University of Illinois, \$1,283,900 to the University of Minnesota, \$985,000 to the Kansas Agricultural College, and \$681,500 to the Oregon college.

The number of secondary schools reporting students in agriculture increased from 630 in 1910 to about 2,000 in 1911 and the number of State-aided courses in agriculture in high schools from 28 to about 250. Since a few high schools having college-trained teachers of agriculture have demonstrated the feasibility and value of teaching agriculture in secondary courses of study there seems to be no limit to the demand for teachers who can do like successful work. The agricultural colleges are organizing courses for the preparation of such teachers, but thus far have been utterly unable to meet the demand.

Among the elementary schools there has been encouraging progress in nature-study work and in the teaching of elementary agriculture. Ohio has been added to the list of States requiring the teaching of agriculture in all rural schools. Supervision of that work is now provided for through the appointment of four State supervisors of rural schools. New York and Oregon are also developing rural-school supervision for elementary agriculture. Nearly all of the Southern States have State rural-school supervisors who are promoting the teaching of agriculture. The enrollment in boys' and girls' agricultural clubs in the South increased from 46,000 in 1910 to 60,000 in 1911.

In an advisory capacity the United States Department of Agriculture continued to aid the State authorities in the promotion of agricultural education through the agricultural education service of the Office of Experiment Stations. The director of this office has continued to act as bibliographer of the Association of American Agricultural Colleges and Experiment Stations, as chairman of its committee on instruction in agriculture and on the history of agricultural education, and as dean of the Graduate School of Agriculture. The agricultural education service, which has remained in charge of Mr. D. J. Crosby, has continued to study the various systems of agricultural education, investigate methods of teaching agriculture, prepare publications for teachers and others interested in promoting the educational efficiency of the people living in the country, bring the large amounts of new information on agricultural subjects published by the department and the experiment stations to the attention of teachers and students, and, in general, to act as a clearing house for agricultural education in this country. In this way 22 different States were given special assistance during the year.

The detailed report of the specialist in agricultural education will be found on pages 277-341.

FARMERS' INSTITUTES AND EXTENSION WORK.

The organization and work of the office of the farmers' institute specialist were not materially modified during the year. As shown in the detailed report given on pages 343-388, there was great activity in this as well as in various other forms of agricultural extension work.

The interest of farming people in institute instruction is steadily growing and extending to embrace new and improved lines of effort. The movable school, the women's institute, the high school, the rural school, the instruction train, and the itinerant teacher have been operating and testing their methods as never before, and large numbers of farming people are being reached through these media.

The awakening of country people to the need of agricultural instruction and to the possibilities of extension teaching has created a demand for this instruction far beyond the power of the States to supply. The inadequacy of our present equipment for meeting the educational needs of rural people has become so apparent that several bills have been presented before Congress looking to additional appropriations for carrying on this work. The States also are adding to their appropriations for agricultural extension in very marked degree. California has increased the appropriation for institute work from \$10,000 to \$15,000 per year; Illinois, \$23,650 to \$29,000; Kansas, \$27,500 to \$35,000; Minnesota, \$18,000 to \$23,000; Nebraska, \$10,000 to \$17,500; New York, \$25,000 to \$35,000; Ohio, \$22,000 to \$26,400; Oklahoma, \$5,000 to \$10,500; South Dakota, \$9,400 to \$13,000; Utah, \$5,000 to \$10,000; and Washington, \$8,500 to \$10,000. Thirty-nine State legislatures appropriated \$347,850.57 to institute work; to this there was added by 18 States \$51,568.75 from other sources, making a total of \$399,319.32. There was expended by 39 States for institute purposes \$342,746.62. The State appropriation for 1912 in 33 States is reported at \$383,600. Comparing the 33 States reporting appropriations by their State legislatures for 1912 with the same States in their appropriations for 1911 the difference in favor of the coming year is \$65,179.61, an increase of over 20 per cent.

The office of the farmers' institute specialist has continued to gather information along extension lines and has compiled and published much of it for the benefit of extension workers. The following publications relating to extension in agriculture were published: Proceedings of the Fifteenth Annual Meeting of the American Association of Farmers' Institute Workers, Farmers' Institutes for Young People, List of State Directors of Farmers' Institutes and Farmers' Institute Lecturers of the United States, Agricultural Fair Associations and Their Utilization in Agricultural Education and Improve-

ment, and The Transportation Companies as Factors in Agricultural Extension, besides the annual report of the farmers' institute specialist for 1910, a translation of the Agriculture of Belgium, 1885-1910, by J. M. Stedman, assistant farmers' institute specialist, and a revision of a bulletin on Legislation Relating to Farmers' Institutes in the United States. A number of addresses for conventions and institute meetings were also prepared. The farmers' institute specialist is secretary of the American Association of Farmers' Institute Workers, and as such has the preparation of the program for the annual meeting and the editing of the report of the proceedings. He is also secretary of the committee on extension work of the Association of American Agricultural Colleges and Experiment Stations and assists the committee in collecting information respecting that work. A large and important part of the work of the office of institute specialist is necessarily done through correspondence, which has grown to large proportions and steadily increases year by year.

PUBLICATIONS.

As in previous years, the office issued publications (1) reviewing the progress of agricultural education and research throughout the world and (2) reporting the results of special investigations in nutrition, irrigation, drainage, and agricultural education. The publications of the office during the fiscal year ended June 30, 1911, comprised 80 documents, containing about 4,700 pages, exclusive of 8 separates, several revised reprints of earlier publications, and a miscellaneous document, which aggregated nearly 700 pages more. The publications included 18 numbers of Experiment Station Record, 15 technical bulletins, 2 reports of the office, 16 circulars, 5 publications of the insular stations, 10 Farmers' Bulletins, including 6 numbers of Experiment Station Work, 3 articles for the Yearbook of the department, and 12 monthly lists of station publications.

There is a steady growth in the volume of agricultural literature, involving an increase in the work and in the amount of printing necessary to present an adequate review of progress in agricultural education and research. To provide for such a review two volumes of Experiment Station Record were issued during the year and arrangements were made whereby two additional abstract numbers of the Record are issued annually.

As time goes on the value of the Record as a great repository of information pertaining to agriculture otherwise available only by an extended examination of the enormous mass of literature which has been published steadily increases. The 24 volumes thus far issued contain references to no fewer than 85,829 articles, besides editorials, special articles, and notes. The experiment station reports abstracted

have alone numbered 956, the station bulletins and circulars 7,956, and the publications of this department 4,488. The carefully prepared author and subject indexes to the individual volumes and the general index to Volumes I to XII have greatly enhanced the usefulness of the Record. Considerable progress was made during the year in the preparation of a similar general index for Volumes XIII to XXV.

The office continued to supplement the Record by a bimonthly review of progress in the more practical lines of investigation at the experiment stations in the Experiment Station Work series of Farmers' Bulletins.

The proceedings of the American Association of Farmers' Institute Workers were prepared and submitted for publication by the department through the office.

The office continued the publication of the card index of experiment station literature.

INCOME.

The income of the office during the past fiscal year, derived wholly from appropriations by Congress, was as follows:

For the general expenses of the office-----	\$79,580.00
For the Alaska experiment stations-----	28,000.00
For the Hawaii Experiment Station-----	28,000.00
For the Porto Rico Experiment Station-----	28,000.00
For the Guam Experiment Station-----	15,000.00
For investigations on agricultural schools and farmers' institutes-----	10,000.00
For nutrition investigations-----	10,000.00
For irrigation investigations-----	70,380.00
For drainage investigations-----	78,860.00
 Total -----	 347,820.00

In addition to the above there was derived from the sale of agricultural products at the insular experiment stations the following amounts:

Alaska experiment stations-----	\$2,661.41
Hawaii Experiment Station-----	46.98
Porto Rico Experiment Station-----	2,006.44
Guam Experiment Station-----	12.33
 Total -----	 4,727.16
Total income-----	352,547.16

WORK AND EXPENDITURES OF THE AGRICULTURAL EXPERIMENT STATIONS.

By E. W. ALLEN and J. I. SCHULTE.

REVIEW OF THE YEAR.

In the fiscal year 1911 the appropriation under the Adams Act (act of March 16, 1906) reached its maximum of \$15,000 to each State. Starting with an initial allotment of \$5,000, the fund has increased annually by \$2,000 up to the maximum, thus enabling a steady growth based on the development of the research work. This provision has afforded time in the working out of plans for the full use of this research fund, and enabled the preparation of men necessary to its successful employment. The result has been unmistakably beneficial. There has been a steady raising of the standard of investigation from year to year, as its spirit and the requirements of fundamental research in agricultural problems have gained wider support.

Much still remains to be done in the direction of strengthening this capstone of the stations' activity. The need is both for more men of genius for investigation, and for administration which will stimulate them, hold them to their projects, and preserve them from interruption. There is still an insufficient number of thoroughly prepared men, and men have been encouraged to enter upon projects who either from qualification or inclination have not fully measured up to the requirements. Until the spirit of research and the desire to pursue it is more uniformly found in those in charge of projects, the productive research will not reach its full capacity and will be confined to a relative few.

The lack of a deep-seated and compelling interest in thorough-going investigation which is still to be found is attributable in some measure to the interruptions which come to the men and to the fact that their investigations are in a sense a side issue. It has been a mistake to divide the fund among so many persons, and to encourage the taking up of projects by men who were not thoroughly qualified or to whom sufficient opportunity could not be held out. Little can be accomplished in research in a desultory, disconnected effort. It calls for thorough, continuous application, free from interruptions which distract and interfere.

The dropping of projects before their completion is one of the drawbacks to progress under this research fund. This has continued

to be far too frequent. The abandoning of lines of investigation before definite and final results have been secured which mark a contribution to the subject results in reality in a waste of money. It arises in part from changes in the station staff, but also from insufficient care in inaugurating the work and a failure of the station management to direct it or to fully appreciate the necessity of systematic continued effort.

The experience of the past five years has clearly shown the inadvisability of accepting blanket projects, or propositions too wide in scope or too indefinite in purpose or method. As a rule, where the project has not been restricted and held to the definite problem, the work has been superficial and scattering and has lacked directness and objectiveness. Every reasonable effort is, therefore, being made to hold to the purpose of the Adams Act and to restrict expenditures from it to those directly connected with definite research projects of high grade.

The list of active projects has shown something of a decrease—290 as compared with 335 the previous year. Twenty-one projects were completed during the fiscal year and 43 new ones were approved and entered upon. In general, the character of the new projects has shown a notable advance and many of the old ones have been restated or developed along more fundamental lines than at the outset.

While the Hatch fund continues to be drawn upon quite heavily for general expenses of administration, the more liberal appropriations for the stations and the colleges with which they are connected have brought marked relief. The Hatch fund is now supporting a larger amount of experimental work, the general character of which is of higher grade. There has been an elimination of the simple tests and demonstrations, and a greater tendency to confine the fund to more thorough studies and investigation. At a number of the stations there is now little real distinction between the grade and purpose of the investigation conducted with the Hatch fund and that conducted with the Adams fund. The influence of the Adams fund and the requirement for the outlining of definite projects have been far-reaching.

In general, there has been a strengthening of the station organization, and a sharper differentiation of its work—at least in principle if not fully in practice. The conception of the experiment station as an agency for acquiring new knowledge is steadily gaining ground, and along with this the necessity of providing conditions which will leave the station forces primarily to conducting their experiments and investigations is brought home more forcibly every year. The growth of both the college teaching in agriculture and the extension activities has emphasized this, for success in both of these

departments depends upon the station work, and their present magnitude points to the need of forces which are largely separate and free from other exacting duties. The organization of these three divisions of effort, the relations of the men composing their forces, and the division of the field are now receiving careful consideration.

INCREASE IN FUNDS AND EQUIPMENT.

The revenues of the stations in 1911 amounted to more than \$3,000,000. Of this amount \$1,539,000 was received from the Federal Government, and the balance was contributed by States or received from local sources. There are now only a few States in which no specific appropriation for the station is made and where the institution has to rely solely upon the Federal funds for conducting its work.

Among the new appropriations for the year the following may be mentioned: In February, 1911, the Legislature of Alabama made a continuing appropriation to the Alabama Experiment Station of \$27,000 per annum. The funds were specifically appropriated as follows: For local experiments with fertilizers and field and forage crops, \$7,000; agricultural extension work, \$5,000; live-stock investigations, \$3,500; for publications and administrative expenses, \$2,500; cotton-boll weevil and other insect-pest investigations, \$2,300; for drainage, irrigation, and farm machinery, \$1,500; for plant-breeding work, \$1,200; for investigating plant diseases, \$1,000; and for promoting the poultry industry, \$1,000. The State appropriation for the Canebrake station was increased from \$2,500 to \$4,000 per annum.

An appropriation of \$10,000 was made by the Delaware Legislature to complete the equipment of the college farm; another \$10,000 was allowed for repairs and maintenance; and \$9,000 was given for extension work.

Idaho appropriated \$13,500 for the purchase of additional farm land adjoining the present experiment farm. A tract of 120 acres has been secured and will be used for experiments in the departments of animal husbandry, agronomy, dairying, and chemistry. The State further appropriated about \$6,000 for the construction of modern and thoroughly equipped dairy barns.

The State Legislature of Illinois made the following annual appropriations for special investigations by the experiment station: Live stock \$25,000, farm crops \$15,000, soils \$65,000, orchards \$15,000, floriculture \$8,000, dairying \$15,000, and soil maps and other publications \$25,000. There was also an appropriation of \$19,000 for live-stock specimens, \$153,000 for buildings, and \$20,000 for purchases of land in which the station is jointly interested with the college.

The State of Indiana appropriated \$10,000 for extension work for the year ended September 30, 1911, and \$30,000 annually thereafter.

in addition to an annual grant of \$10,000 for extension work by the station.

The Iowa Experiment Station has a permanent State appropriation of \$15,000 a year, and the last State legislature made an additional annual grant of \$15,000. The State also appropriated \$50,000 yearly for extension work.

The State of Kansas appropriated for the biennium \$45,000 for the station, \$75,000 for extension work, \$46,300 for the Fort Hays substation, \$7,500 for the Garden City substation, and \$125,000 for an addition to the agricultural building at the college.

At the Michigan station a soil house was constructed for the purpose of conducting soil investigations under the Adams fund, and a piggery was built for use in connection with the preparation of hog-cholera serum.

The Minnesota station completed during the year an experimental industrial alcohol plant, with a capacity of 100 proof gallons per day. The extension department of the college is maintained annually with \$25,000 and \$2,500 additional for dairy extension work.

The Missouri station purchased 80 acres of land for its horticultural department. The new buildings recently completed and their costs were as follows: Veterinary laboratory, \$30,000; wagon and implement barn, \$2,000; dairy barn, \$12,000; hog-cholera serum laboratory, \$1,500; and cattle sheds, \$300. This station also has for the year 1911-12 for outlying experiments, \$15,000; hog-cholera serum manufacture and distribution, \$25,000; for agricultural laboratories, \$8,000; for running expenses of the station, \$20,000; and for a State soil survey, \$12,000. A number of other appropriations were made in which the station is jointly interested with the college.

The Montana station has available for the biennium \$42,500 for the station, \$10,000 for dry farming and horticultural substations, \$36,000 for demonstration work in dry farming, and \$23,500 for buildings and other improvements. At the station at Bozeman \$10,000 was used in the erection of greenhouses.

At the Nebraska station a steer-feeding plant was completed for \$11,200. Improvements made at three substations amounted to \$21,050. For the biennium beginning April 1, 1911, the North Platte substation is provided with \$30,000, the Valentine substation with \$15,000, and the Scotts Bluff substation with \$5,000. There was further appropriated \$15,000 for a serum plant at the main station at Lincoln, \$35,000 for agricultural extension, and \$85,000 for a building for agricultural botany, horticulture, and entomology.

The Nevada Legislature made an appropriation of \$2,000 for climatological work and \$3,000 for general station work.

For the current biennium the New Hampshire station received \$5,000 for a horse barn, \$3,000 for the purchase of live stock, \$1,500

for printing bulletins, \$5,000 for extension work, and \$10,000 for general running expenses.

The New Jersey Legislature in 1911 made an appropriation of \$15,000 for buildings and equipment in connection with poultry experiments, together with \$3,000 annually for the maintenance of such work. For buildings and equipment in connection with floricultural work \$11,000 was appropriated and for its annual maintenance \$3,000. The station also has an annual appropriation of \$3,000 for work in plant pathology, \$2,000 for the investigation of bee diseases, and \$10,000 for live-stock problems.

In addition to its regular appropriations, the New York State station at Geneva was allowed \$15,500 for the purchase of farm land near the station.

The station of the North Carolina Department of Agriculture had available about \$70,000 for experimental, demonstration, and farmers' institute work.

The Ohio station has an appropriation of \$195,300 for the different station departments for the year 1912. For the year 1911 it had \$203,090, of which \$39,855 was for land and buildings.

The Oregon station has available for the year 1912 \$15,000 for work on fruit pests and diseases and other horticultural problems, \$10,000 for general station work, and \$16,000 for the different substations at Union, Moro, Hermiston, Harney Valley, and the substation in southern Oregon.

The South Carolina station and college constructed a dairy building at a cost of \$25,000 and a dairy barn for \$15,000.

The State of Texas made an annual appropriation of \$25,000 and a deficiency appropriation of \$3,000 for the series of State substations.

The Utah Legislature in 1911 made a permanent yearly appropriation of \$15,000 for the maintenance of the substations. The appropriation for extension work was increased and placed on a permanent annual basis of \$10,000.

The Virginia truck experiment station erected a greenhouse at a cost of \$2,320.75 and installed a Skinner irrigation system covering about 4 acres of land at a cost of \$831.71.

The State of Washington early in 1911 included, among other appropriations for the ensuing biennium, \$20,000 for farmers' institutes and \$30,000 for the Puyallup substation. A law providing a tax of 0.325 mill on the assessed valuation of the State for the support of the college and station for the years 1913-1918, inclusive, was also passed.

At the Wisconsin station a new horticultural building costing \$50,000 and greenhouses \$10,000, with \$8,000 for equipment, and a \$20,000 addition to the dairy laboratories were completed. A

new domestic science building and a new chemical building, to cost \$75,000 and \$90,000, respectively, are in course of construction. The appropriation for extension work now amounts to \$40,000 annually.

SUBSTATIONS AND DEMONSTRATION FARMS.

Progress was made during the year in providing for practical experiments for local conditions, and the application and adaptation of methods and crops to particular localities and conditions, by establishing or providing for substations and demonstration farms in a number of States. So far as these are experimental they are regarded as forming a part of the stations' work, rather than coming under the head of extension work. Frequently, however, the division is not complete in all respects.

The State of California appropriated \$25,000 for a building for a citrus substation and its equipment, to be located at Riverside.

The Territorial Legislature of Hawaii made a grant of \$20,000 for the biennium for maintaining demonstration farms on the various islands.

At the Louisiana college and station a truck farm was established at Baton Rouge, partly for the purpose of studying the marketing of truck produce in the North. G. L. Tiebout, of the station staff, was placed in charge of this farm.

The possession of a cranberry bog was secured by the Massachusetts station during the year. Improvements were carried out and experimental work was begun. The tract is located at East Wareham, Mass., and contains about 23 acres, including 12 acres of made bog, with provision for flooding by means of a pumping plant put in at a cost of about \$2,000.

In Michigan the Upper Peninsula substation at Chatham received as a donation from the Cleveland Cliff Iron Co. 600 acres of land adjoining the station property.

By an act of the Minnesota Legislature, approved April 13, 1911, \$65,000 was appropriated for the purchase of land, equipment of a station, and its maintenance for two years, to be located at Duluth; and \$35,000 for the purchase of land, equipment, and maintenance for two years of a substation to be located at Waseca.

The Legislature of Missouri of 1911 passed an act appropriating \$5,000 for the purpose of establishing a State poultry experiment station at Mountain Grove on 25 acres of land used by the State Fruit Experiment Station, and \$5,000 additional for its maintenance.

The Nebraska Legislature of 1911, by an act approved April, 1911, appropriated \$15,000, to be expended by the State board of regents for the establishment of a substation near Culbertson. The act makes the provision that in the event that the Southwest Nebraska Agri-

cultural School is established within 30 miles of Culbertson the appropriation shall be available for experimental work only at such school.

The Board of Control of Ohio, acting conjointly with the boards of county commissioners, has located county experiment farms in Belmont, Paulding, and Miami Counties, under the Wilber law of 1910. The bonds voted for this purpose amounted to \$20,000 each in Belmont and Paulding Counties and \$22,000 in Miami County.

In 1911 acts were passed by the State Legislature of Oregon appropriating annually \$4,900 for the support and maintenance of a substation in Harney County for the investigation and demonstration of dry, arid, and nonirrigated lands of the State, and also authorizing the establishment of a branch station in southern Oregon, with an annual appropriation of \$5,000 for its support and maintenance.

In South Dakota the legislature of 1911 instructed the regents of education to locate a dry-farming substation on 160 acres of State lands in Fall River County, and appropriated \$1,000 for maintaining this station in 1912. A law was also enacted allowing county commissioners to establish demonstration farms and to appropriate \$300 annually for the expense of State supervision of each, and also providing that county poor farms may be conducted as demonstration farms. Under this law private individuals may conduct demonstration farms under State supervision by agreeing to devote not less than 40 acres for the purpose, to carry on the work 5 years, to use only the best seed, and to sell the crops for seed purposes at a reasonable price to the people of the vicinity.

In Tennessee the farmers' convention of the State subscribed \$10,000 for a stock-judging pavilion to be erected at the substation at Jackson, and a donation of \$1,000 for the benefit of the same institution was made by a private party.

The Texas Legislature of 1911 appropriated \$6,000 for two years for the purpose of establishing an experiment station to demonstrate the possibilities of tobacco growing in the seventeenth congressional district of the State. The work is to be cooperative with this department.

In Utah another demonstration farm was established near Cedar Fort station, in Cedar Valley. Two of the former demonstration farms located on sagebrush land, having accomplished their purpose of demonstrating the profitable handling of such lands under dry-farming methods, have been discontinued. The new station established in Cedar Valley encounters somewhat different conditions than those met with on the sagebrush areas. Another station has been established near Ajax on "shad-scale" soil, of which the State contains great areas. The demonstration work on the sagebrush land has been largely instrumental in the taking up of these lands for

agricultural purposes. The Indian school and farm at Panguitch was turned over to the experiment station, with a preliminary appropriation of \$2,500 to commence experiment and demonstration work.

The State of Virginia passed a bill creating a united agricultural board, and appropriating \$5,000 a year to the experiment station for establishing and maintaining district substations. The term "district" is meant to cover a section of the State usually embracing a number of counties having approximately similar conditions of soil, climate, and agricultural practice.

CHANGES IN PERSONNEL.

During the year comparatively few important changes in the station staffs took place. The only new appointee to a directorship was James A. Wilson, superintendent of the Murray State School of Agriculture at Tishomingo, Okla., who was appointed director of the Oklahoma station. Since the close of the year the directorship of the Texas station was taken over by B. Youngblood, formerly connected with this department, and that of the New Jersey stations was entered upon by J. G. Lipman, in charge of soil chemistry and bacteriology at that station. L. H. Moore was appointed director of the Alabama Canebrake station, vice F. D. Stevens, resigned. Quite recently E. R. Lloyd was appointed director of the Mississippi station in place of J. W. Fox, resigned, and E. D. Sanderson succeeded to the directorship of the West Virginia station after the retirement of J. H. Stewart.

The necrology list of the year is fortunately also a short one. Dr. E. B. Voorhees, director of the New Jersey stations, died early in June. A brief account of his life and services is given below. Frank J. Phillips, head of the forestry department of the Nebraska college and station since 1907, died February 13, 1911. The death of Raymond H. Pond, plant pathologist of the Texas station since 1909, occurred on July 26, 1911. Prof. F. H. King, widely known for his research in soil physics and as the author of the King system of ventilation, long connected with the Wisconsin experiment station, and also for a time with this department, died at his home in Madison, Wis., August 4, 1911, at the age of 63 years.

DR. EDWARD B. VOORHEES.

Dr. E. B. Voorhees, for nearly 30 years connected with the New Jersey experiment stations in the capacity of chemist and director, and for 20 years professor of agriculture in Rutgers College, died June 6, 1911.

Edward Burnett Voorhees was born at Minebrook, Somerset County, N. J., on June 22, 1856. He was graduated from Rutgers College in 1881 with the degree of bachelor of arts, and in 1900 he

received the honorary degree of doctor of science from the University of Vermont. The year following his graduation he served as assistant to the professor of chemistry at Wesleyan University, Dr. W. O. Atwater, and in 1882 he returned to New Jersey as assistant chemist in the experiment station, continuing in this position until 1888, when he was made chemist of the station. In 1890 he was appointed professor of agriculture in Rutgers College, developing agricultural instruction in that institution almost from the beginning and leading the State to the establishment of short courses in agriculture. Dr. Voorhees was made director of the New Jersey State station in 1893, and three years later the directorship of the college station was combined with that of the State station. He continued to hold the directorship of these institutions until the time of his death.

Dr. Voorhees was a type of the present generation of leaders in agricultural advancement. He was trained under the pioneer workers in agriculture and entered upon constructive activity with the extension of the national movement in the establishment of the experiment stations. Of this opportunity he availed himself in a marked degree and with his characteristic vigor and aggressiveness became highly successful in organizing and propagating experiment station work and making its results felt by farmers. Under his direction the inspection work of the stations was put upon a high plane of efficiency and usefulness, and the research and experimental work were developed in accordance with definite plans and an intelligent understanding of the needs of the State. He was a pioneer in teaching the farmers the practice of home mixing of fertilizers, to economize cost, and secure suitable mixtures for different purposes. An ardent champion of honest goods, he waged an aggressive campaign against the incorporation of materials which his experiments showed to be inert and of little agricultural value.

With remarkable energy and enthusiasm Dr. Voorhees encouraged and promoted the diversification of agriculture in his State, the introduction of new crops, and the establishment of the new branches of farming. The system of soiling crops for dairy cattle which he worked out and demonstrated at the station farm was an example of intensive farming under which the purchase of expensive grains was greatly reduced. The successful establishment of alfalfa in New Jersey, to which it is estimated 1,000 acres were seeded during the past year, is a direct result of his experiments and teaching. He gave special study to the waste or poorer soils of the State and their utilization for profitable farming, and at one time he devoted considerable attention to the use of irrigation as an adjunct in the humid region.

As an independent investigator Dr. Voorhees was clear in aim and purpose and quick to see the practical applications of his experi-

ments, which were conceived for the most part with the primary object of throwing light on practical, everyday problems of farming. Among other research work he carried on an elaborate series of studies on nitrogenous fertilizers which proved of such merit that it received international recognition. The department of soil bacteriology was established through his initiative, and the station became a pioneer in this particular line of investigation. In 1902 he was awarded the Nichols medal by the New York section of the American Chemical Society for the best paper embodying the results of original chemical research submitted during the year. This embodied the results of studies in nitrification.

Dr. Voorhees was identified with many scientific societies and organizations. For many years he took an active part in the study of methods of analysis conducted by the Association of Official Agricultural Chemists, and he was president of that organization in 1893-94. From 1897 to 1904 he was secretary-treasurer of the Association of American Agricultural Colleges and Experiment Stations, and was president of the association in 1904-5. He served as vice president of the New Jersey State Board of Agriculture from 1893 to 1901, and was its president from the latter date to the time of his death. He was also president of the board of directors of the New Jersey Weather Bureau in 1903, president of the New Jersey Microscopical Society in 1905-6, and a leader on the State conservation commission.

Dr. Voorhees's death removed one of the most active and effective workers of the present time. The service he rendered to his State has rarely been surpassed, and his influence was felt far beyond its borders.

SOME RESULTS OF STATION WORK.

A brief mention of some of the important results obtained will give a general idea of the scope and progress of this work, which is organized on a national basis but is dealing primarily with the problems of the individual States.

The Colorado station demonstrated the occurrence of apparently rapidly extending areas of soil in irrigated orchards and sugar-beet fields containing nitrates in such excessive amounts as to destroy the crops. Soils were found containing as high as 6.5 per cent of sodium nitrate, and in one case 93 per cent of the nitrogen of the soil was in the form of nitrates. This excess of nitrates appears to be due to phenomenal bacterial activity.

The Delaware station, in cooperation with this department, worked out a method for quickly immunizing against anthrax in case of an outbreak, and produced a serum with which it was possible to protect a sheep against an otherwise mortal dose of anthrax bacilli and to produce an immediate passive immunity.

In its studies of citrus diseases the Florida station ascertained that the fungus causing stem-end rot is present in the orchard during practically the entire year, being found on dead and partially decayed branches and twigs when the fruit is immature or not in the groves.

Results secured at the Idaho station showed a marked increase in protein content of several varieties of wheat grown on land cropped the previous year with potatoes, as compared with land in wheat the year before. Irrigation investigations at that station showed that wheat receiving from 18 to 20 inches of water during the season gave a yield of over 50 per cent above wheat receiving no water.

The soil investigations of the Illinois Station have turned the tide of sentiment within the State from one of soil depletion to one of soil upbuilding, as evidenced by the interest farmers and business men are showing in the work, and in the application of the principles advocated by the station by leading farmers everywhere throughout the State. Among other results secured by the station during the past year was the fact that within reasonable limits gain in weight in growing animals is not in proportion to the feed consumed, and that contagious abortion as known in this country is practically identical with the disease as known in western Europe.

The results of dairy investigations at the Indiana station showed that an excess of soft fats and large average fat globules in cream materially increase the moisture absorbing and retaining property of butter, while the acidity of cream, the size of butter granules, the temperature of the wash water, the use of the dry or wet salting method do not appreciably affect the moisture content of this product.

The work in agronomy at the Kansas station brought out quite clearly that the time and the method of seed-bed preparation for wheat very materially influenced the yield, especially in a dry season. Land disked but not plowed produced 4 $\frac{1}{4}$ bushels of wheat per acre, while land plowed at the right time, July 15, and at the right depth, 7 inches, gave a yield of 38 $\frac{1}{3}$ bushels per acre.

The Kentucky station established a practically accurate and reasonably rapid method for detecting *Bacillus typhosus* in water, having used the same with success, and in one case obtaining a positive result as early as the fourth day.

In a study with a view to adapting the carbonation process of clarifying cane juices, the Louisiana station discovered features in regard to temperature and alkalinity which enabled it to remove experimentally a much greater percentage of impurities than has heretofore been possible in sugarhouse practice. This station also demonstrated that the fuel efficiency of bagasse can be materially increased by utilizing the flue gases in drying this product, and showed

further how moisture contained in bagasse and other conditions influence its fuel value.

The Missouri station determined that nitrogen and phosphorus are the limiting elements of plant food in Missouri soils, and that the majority of Missouri uplands respond to an application of these elements. The results of orchard work showed that proper pruning alone on a given plat of peach trees resulted in a yield giving net returns of \$125 per acre. Proper fertilizing with ammonium sulphate on another plat in the same orchard resulted in a yield of \$40 per acre net, while on a plat where proper pruning, fertilizing, and spraying were all combined the peaches yielded at the rate of a net profit of \$300 per acre after paying the expenses of management and shipping crop to market.

It was also demonstrated by the Missouri station that the practice of maintaining young heifers on a high plane of nutrition does not affect their milking qualities, and that the size of the cow may be permanently increased by liberal feeding when young. In experiments to determine the efficiency of mitigated cultures of human tubercle bacilli as a vaccine against bovine tuberculosis, the station found that vaccinated cattle contracted the disease when exposed to infected animals even under the favorable conditions of an outdoor life. The fecal excretions of tuberculous cattle were a much more important source of infection to swine than foods contaminated with the saliva of tuberculous cattle. It was shown that not only a very large percentage of the pigs fed behind tuberculous cattle became infected with the disease, but that some of the pigs show well-developed tubercular lesions in less than four weeks of exposure. The station continued the manufacture of hog-cholera serum and distributed 60,000 doses during the year.

During the dry season of 1911 the new varieties of timothy originated at the Cornell station brought out strikingly their superior qualities, the average yield for 17 new varieties being 7,153 pounds per acre, as compared with 4,091 pounds for seven check plats of ordinary timothy. Corn-breeding work with two different varieties has resulted in each instance in a gain of about two weeks in earliness or time of maturing. Oat hybrids and selections made by the station and tested for five seasons have also shown marked improvement in yielding capacity as compared with common sorts. Analyses of drainage waters showed a loss of calcium of over 200 pounds per acre more on fallow than on soil growing corn and oats.

The New York State station has worked out a method for the preparation of lime-sulphur wash which enables fruit growers to make their own preparations at a very considerable saving.

The North Dakota station demonstrated that old land is just as suitable for growing flaxseed as new land. From experiments and observations made by the station the conclusion was drawn that soil

deterioration from a chemical standpoint exists in the principal flax and wheat regions in insufficient form to account for the deteriorated yields in quantity and quality, and the deterioration along these lines is attributed to insanitary soil conditions. The station has worked out specific rotations and methods of culture and seed treatment tending to reduce the activity of these soil troubles.

The Ohio station demonstrated the practicability of eradicating bovine tuberculosis and of building up a herd of sound animals from the progeny of tuberculous cattle by the systematic use of the tuberculin test and the thorough disinfection of barns. The station also found that there exists a direct relation between the supply of available phosphorus in the soil and phosphorus in the grain of wheat grown upon it. The results of a study of the mineral nutrients in blue grass indicated that some blue-grass pastures in the State contain twice as high percentages of the mineral nutrients as others, these differences being due to differences in the soils upon which the grasses were grown. It was also found that the content of blue grass in mineral nutrients may be very greatly increased by the use of fertilizers.

A method of budding the walnut was worked out by the Oregon station. This method is based on the principle of securing dormant 1-year-old buds, while propagators heretofore have attempted to use buds of the current year's growth.

Work of the Utah station has shown that Turkey Red wheat is the best yielding winter wheat for the State, and that the flour produced from it is the best and equal in quality to any produced in other parts of the country. The work in dry farming conducted by the station on sagebrush land has shown the practicability of farming these lands under dry-farming methods, and as a consequence the greater portion of the sagebrush areas of the State have been taken up.

The results of 20 years' spraying work with Bordeaux mixture on late potatoes by the Vermont station showed an average yield per acre of 268 bushels for the sprayed and of 163 bushels for the unsprayed crops. This represents an average gain of 105 bushels per acre, or an increase of 64 per cent in favor of spraying.

The Wisconsin station found that silage as compared with soiling crops can be fed to greater advantage to dairy cows through the summer season. In its work on weed eradication this station found that a crop of hemp, after cultivated summer fallow, was very effective in killing out quack grass and Canada thistle. In studying the relation of soil bacteria to evaporation, this station found that bacterial activity in the soil may so change the nature of substances in solution in the soil water as to exert an influence upon evaporation.

PROGRESS IN FOREIGN COUNTRIES.

General agricultural experiment stations were established during the past year at Linz, Austria; La Rioja, Argentina; Therezina, Brazil; San Jose, Costa Rica; Carcassonne, France; Kissidougou and Mamou, French Guinea; Bettiah Estate, Bengal, India; and at Burgos and Pontevedra, Spain. With the object of improving agricultural and stock-raising conditions in the Pampa Central Territory the Argentine Government proposes to establish agricultural stations throughout the entire district, commencing with Villa Iris, Bernasconi, Epuvel, Quehec, Macachin, and Guatrache.

Special experiment stations, or those working along particular lines or with special crops, were also established in many of the foreign countries. A station for cacao culture was established at San Antonio, Brazil; one for rubber culture at Issororo, British Guiana; a viticultural station at Toulouse, France; a forestry station at Chimnitz, Hungary; a station for beet culture at Rovigo, Italy; experimental gardens and laboratories of agricultural chemistry, vegetable pathology, and entomology at Fort de France, Martinique; an experiment station for cotton culture at Port Herald, Nyasaland Protectorate; a rice experiment station in the Department of Lambayeque, Peru; and in Spain enological stations at Aranda de Duero, Felanitx, and Valdepenas; a viticultural station at Madrid; and a station for olive culture at Tortosa. The Spanish Government has also on foot a project to spend 2,000,000 pesetas in supplying the existing agricultural schools and experiment stations with modern necessary equipment.

Model and permanent demonstration farms were established in Brazil at Bemfica, and one for coconut culture in the State of Espirito Santo; in India at Suri, Bengal; and in Santo Domingo a tobacco experiment field at Jacaguas. Botanical stations were established on the Island of Carriacou, British West Indies, and at Eala, Belgian Kongo.

In Canada steps were taken to establish three new experiment stations, one at Fort Resolution, one at Fort Smith, and the third at Fort Providence. These three stations in the Northwest will carry the experimental work about 150 to 200 miles farther north than heretofore attempted. The Province of Alberta has taken steps to establish five demonstration farms at a total cost of \$125,000. These farms are all to be different, and in addition to the set of model farm buildings a public hall for short course schools is to be erected. A bulletin containing details, plans, and cost of the farm buildings is to be published as a guide to farmers. An experimental farm was established at Cap Rouge, Quebec. This farm contains 320 acres, and the experimental work to be conducted there will be along the lines

of animal husbandry and the culture of cereal, root, and forage crops. A forest nursery station under the management of a tree-planting inspector was established at Indian Head, Saskatchewan. Experiment stations were also recently established at Kentville, Nova Scotia; Rosthern, Saskatchewan; Ste. Anne de la Pocaterie, Quebec; and at Wilmer, British Columbia.

In Germany Prof. A. Backhaus established an experiment farm at Quednau for the purpose of applying the principles of agricultural science which he expounds in the lecture room. This is a private undertaking and is entered upon through the conviction that if satisfactory results are to be obtained from the study of agricultural science practice and theory must go hand in hand. Three systems of farming have been adopted for comparison.

In England the Norfolk Experimental Farm at Little Snoring was established without any aid from local, imperial, or public funds, the establishment having been effected by the landowners and farmers of the county of Norfolk. The farm contains 132 acres provided with suitable buildings, and was given rent free for eight years by Lord Hastings, and over \$6,000 was raised by subscription to further the enterprise. An experiment station was also organized at Burbage, Leicestershire, for the purpose of applying Mendelian methods of research to the practical breeding problems of agriculture, horticulture, and forestry. Commercial nurseries, comprising over 100 acres, will be utilized for the experiments as far as possible.

In Italy provision was made for the establishment of an experimental mulberry station at Ascoli, with an appropriation of \$14,000 for the establishment and \$4,000 annually for maintenance. The Government also appropriated \$30,000 for the improvement of cultural methods and \$20,000 for itinerant instruction in mulberry culture. An agricultural chemical laboratory was established at Forli for making chemical analyses, experiments in cultivating new plants, and for the diffusion of practical agricultural knowledge. The Government appropriates \$1,400 annually, the Province \$800, the community \$400, a savings bank \$200, and the agricultural commission \$20.

In 1910 Greece established a ministry of agriculture and commerce, and agriculture was further benefited by the work of the Grecian agricultural society, which established agricultural experiment stations, and was active in other ways to improve agriculture in that country.

In Rhodesia an agricultural experiment station was established at Gwibi, 18 miles from Salisbury. The station had 200 acres under crop during the past year, and gave special attention to maize, winter forage, and seed crops and the propagation of Mauritius hemp.

A botanical experiment station was established at Salisbury on a piece of land containing 13 acres. Experimental work is conducted on a plat scale, and attention is given to the introduction of new forage crops, cereals, grasses, etc. Plant breeding with maize and wheat is to be undertaken.

INSPECTION OF THE STATIONS.

In accordance with the usual practice of the office a personal inspection was made during the year of the work and expenditures of every experiment station receiving Federal funds. In connection with this inspection a large amount of first-hand information was secured in regard to the progress of these institutions, and the opportunity was embraced for conference with the local station officers in regard to the work and administration. This inspection was participated in by four members of the office force, namely, the director (A. C. True), assistant director (E. W. Allen), W. H. Beal, and Walter H. Evans.

The following reports upon the several stations are based on the results of this inspection, together with the annual financial statements of the stations rendered on the schedules prescribed by the Secretary of Agriculture, and the printed and other reports received from the station officers:

ALABAMA.

**Agricultural Experiment Station of the Alabama Polytechnic Institute,
Auburn.**

Department of the Alabama Polytechnic Institute.

J. F. DUGGAR, M. S., *Director.*

During the past year the Alabama station was much encouraged in its work by the provision of a continuing State appropriation of \$27,000 annually for local experiments and special investigations. The funds were appropriated specifically as follows: Local experiments with fertilizers, field crops, and forage plants, \$7,000; agricultural extension work, \$5,000; live-stock investigations, \$3,500; publications and administrative expenses, \$2,500; cotton-boll weevil and other investigations, \$2,300; horticultural investigations, \$2,000; drainage, irrigation, and farm machinery, \$1,500; breeding of field and forage crops, \$1,200; investigation of plant diseases, \$1,000; and promotion of the poultry industry, \$1,000. In several of the departments of the station, including those of animal husbandry, agronomy, and horticulture, the sums apportioned are intended to be used wholly for experimental work. These appropriations were made by the legislature in February, 1911, and the different lines of work were

inaugurated during the remaining months of the fiscal year. A law was enacted establishing a State board of agriculture and making the director of the station a member of this board.

All Adams fund projects were continued, and the results of some of the studies were ready for publication at the close of the year. The study of the scientific problems involved in immunity and resistance of the peach to brown rot was carried forward. In this connection an effort was made to breed strains of peaches resistant to brown rot, and a number of seedlings secured in this work and giving some evidence of resistance to the disease were under observation.

The entomologist gave considerable time to the study of the rice weevil (*Calandra oryzæ*), a pest injurious to corn in Alabama. A general account of the life history of this insect was published. It was found that about 32 days and a temperature of 63° F. are required to complete the larval stages from oviposition to the emergence of the adult. The average duration of the life cycle in August and September was from seven to eight weeks. Preliminary experiments on the control of the insect showed that the rice weevil is very resistant to the action of carbon bisulphid. The study of the factors governing the production, diffusion, and insecticidal efficiency of hydrocyanic-acid gas and carbon bisulphid was carried on in connection with the experiments on the control of the rice weevil. Important additions were made during the year to the equipment for the study of fumigation.

In the study of fertilizer requirements as shown by the analysis of cotton plants, laboratory experiments in wire baskets and sand cultures in large cylinders were made to confirm the results secured in the field. During the year three types of soil were studied for crop production, and the results obtained indicated that in general the composition of the plant is influenced by the kind of fertilizer used, particularly in regard to the potash.

The past year's work was the fifth on the corn-breeding project. A considerable number of hybrids have been produced up to this time, and from the data thus far worked up a number of correlations seem to be definitely established. Similar correlation studies were conducted with cotton and oats.

A report was made on the study relating to the effect of different feeds, including cottonseed meal, tankage, soy beans, and peanuts, on the quality of pork. Pasturing the hogs on soy beans was found to produce a soft lard, and attention was given to the question of hardening the lard and meat after they have been rendered soft by grazing hogs on soy beans. In conjunction with this work over 100 samples of lard were studied during the year, together with the acidity of lard in fresh and rancid condition.

The veterinarian continued the study of the bacterial flora of the cow's udder, giving special attention to pathological lesions.

The study of the physiology of the fruit of the persimmon progressed, and preliminary reports were published. It is believed that the tannin occurs in the fruit as a colloidal mass rather than as a precipitate. The investigation of the physiological activity of the cotton plant was continued, and data were recorded with reference to transpiration, evaporation, sun and shade temperatures, the effect of wind, light, intensity, and other factors.

A number of different lines of work were carried on progressively with the Hatch fund. The work of the horticultural department included cultural and other tests on potatoes, beans, cabbage, and other garden crops, and orchard work with pears for blight resistance, pruning, and grafting as a means of orchard renovation, and studies on citrus hybrids, Satsuma oranges, and other fruits of this class. Cooperative work was in progress in several of the more important trucking regions of the State, and attention was given to the advancement of the culture of pecans and Satsuma oranges in Alabama.

A large amount of miscellaneous work in progress in agronomy included variety studies of cotton, nitrogen experiments with various crops, experiments with phosphates, observations on forage plants, especially clovers and soy beans, soil improvement, the effect of soil treatment on subsequent crops, testing the use and value of concrete tile, and other lines of work of a similar nature.

The chemist carried on laboratory and field experiments with open-hearth basic slag, averaging about 12 per cent of phosphoric acid. He also gave some attention to the manufacture of cane sirup in small quantities.

In addition to his connection with Adams fund work the veterinarian studied osteoporosis in horses, intestinal parasites of poultry, dogs, and other domestic animals, and the value of trypanblue as an immunizing agent against tick fever.

The department of animal husbandry continued its cooperative work with this department in cattle feeding, the special points considered being the raising of beef cattle, wintering steers, and fattening cattle on pasture in Alabama. Attention was further given to calf feeding in winter, early lamb production, and the effect of cottonseed meal when fed to ewes.

The Alabama station conducts extension work under the appropriation mentioned above and in cooperation with this department. The station continued to give assistance in farmers' institute work to boys' corn clubs, girls' tomato clubs, and to teachers of agriculture in the public schools.

The following publications of the station were received during the year: Bulletins 150, Raising Beef Cattle in Alabama; 151 (1) Wintering Steers in Alabama, (2) Fattening Cattle on Pasture in Alabama; 152, Self-boiled Lime Sulphur and Its Use; 153, Experiments with Cotton; 154, Corn, Soy-bean Pastures, Tankage, Cotton-seed Meal for Fattening Hogs; 155, The Pecan in Alabama; Circulars 5, The Boll-weevil Advance in Alabama; 6, Fighting the Boll Weevil; 7, Destroying Boll Weevils by Clean Farming; and 8, Budworms in Corn.

The income of the station for the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation -----	13,500.00
Farm products-----	775.76
Miscellaneous-----	2,593.66
 Total-----	 46,869.42

The material assistance given by the State will enable the station to place extension work on a definite and proper basis, and meet other needs of the institution. The results of the station work are showing themselves in an increased interest in the State in the raising and feeding of live stock, the production of forage crops, the combating of insect pests, and the readiness with which farmers participate in the station cooperative work.

Tuskegee Agricultural Experiment Station, Tuskegee Institute.

Department of the Tuskegee Normal and Industrial Institute.

G. W. CARVER, M. Agr., Director.

There was no material change in the lines of work of the Tuskegee station during the past year, and the station staff remained practically the same as the year before. The work advanced along the lines of cotton breeding, alfalfa culture, variety and culture tests of soy beans, and the renovation and improvement of worn-out soils in agronomy. Experiments were conducted with garden crops in horticulture, and poultry raising and feeding dairy cows received attention in animal husbandry. Work was also done in pork packing and butter making.

A study was made of the colored clays, of which rich deposits occur in Macon County where the station is located. The station called attention to the value and the various uses of these clays and pointed out particularly how they may be employed as substitutes for lime whitewash, kalsomines, and paint in interior as well as exterior work.

A bulletin for use in teaching cotton culture in the rural schools was issued during the year. This was partly based on observations made by the station. The different steps in the culture of cotton are

described and the methods of cross-pollinating the blossoms of the cotton plant as a means of improving the crop are given in detail.

The officers of the station continued to take part in agricultural extension and farmers' institute work among the rural negro population of the State.

The following bulletins were received from the station during the year: Bulletins 18, Nature Study and Gardening for Rural Schools; 19, Some Possibilities of the Cowpea in Macon County, Ala.

The Tuskegee Experiment Station, maintained by State appropriation, is making progress in its particular field and is finding increasing appreciation of its efforts among the people for whose benefit it was established.

ALASKA.

Alaska Agricultural Experiment Stations, Sitka, Kodiak, Rampart, and Fairbanks.

Under the supervision of A. C. TRUE, Director, Office of Experiment Stations, United States Department of Agriculture.

C. C. GEORGESON, M. S., *Special Agent in Charge, Sitka.*

During the past year there were a few changes in the personnel of the Alaska stations, but there was little interruption of the work. Some additions were made to their equipment, the most important of which are a stock and hay barn and an additional 100-ton silo at the stock farm on Kalsin Bay; a silo and dairy barn at Kodiak; a barn, a well, and a frost-proof cellar at Fairbanks; and a barn and implement shed at Rampart.

The work at the Alaska stations was carried out during the past year in accordance with the plans outlined in former reports. At Sitka, horticultural and plant breeding work was given prominence. At Rampart, the principal work was in testing and breeding varieties of grain and in experiments with potatoes and hardy leguminous plants. Farming on a commercial scale was carried on at Fairbanks, and at Kodiak breeding and care of live stock were the principal investigations.

Plant-breeding work at the Sitka station included tests with hybrid strawberries and with crosses between the salmonberry and the cultivated raspberry. Nearly 200 hybrids produced by crossing the native strawberry with a cultivated variety showed characters warranting further tests, and about 35 varieties produced berries improved in size and flavor. The test orchard set out in 1903 during the past season produced the first mature apples, six introduced varieties bearing fruit of medium size and good quality. Work in hybridizing native crab with other varieties was carried on and tests were continued with cherries and plums and with gooseberries, currants, raspberries, and other bush fruits. The Early Richmond cherry pro-

duced abundantly and seemed better adapted to its surroundings than the others. The possibility of growing vegetables has already been demonstrated by this station and its efforts were, therefore, confined to determining the varieties giving the best results.

At the Rampart station, 30 acres are now under cultivation, 4 acres having been added during the past year. The work here consisted of testing varieties of grain, cross-breeding promising varieties, the introduction of hardy leguminous plants, and testing vegetables. Where rye and wheat were sown in the fall and well covered with snow, they came through the winter and matured a considerable portion of their crop. Winter rye and winter wheat were injured by severe freezing in the early winter before snow covered the ground. A number of crosses of varieties of barley have been made and in the first generation some appeared to have desirable qualities. Work to secure pedigreed stock of known superiority was carried on with all grains grown at the station. Some of the Siberian alfalfas were introduced and the plants of some withstood the winter without apparent injury. As a result of 10 years' work at this station it appears that grain growing is practicable in the interior of Alaska and that it can be made a success in many parts of the broad interior valleys.

An experiment with potatoes was carried on at Sitka, Fairbanks, and Rampart with practically the same results at each station. Tubers allowed to sprout in the light for four weeks before planting yielded in nearly every instance an increase of 10 per cent or more in the total crop with a proportionate increase in marketable tubers.

At the Fairbanks station in 1911 the value of the potatoes grown on 7 acres was estimated at about \$2,500. In variety-test plats, yields of from 120 to 300 bushels per acre were obtained. The same year 30 tons of oat hay were produced on 25 acres of light soil. All early varieties of oats, barley, and fall grains where the latter had a good snow covering matured, and the results with vegetables, especially with cabbage, cauliflower, rutabagas, carrots, etc., were also quite satisfactory. Twenty-three acres of land were cleared, and the station now has 93 acres of cleared land, 70 of which are in cultivation.

Satisfactory progress was made at the Kodiak station, where there are now 85 head of pure-bred Galloway cattle of all ages, 10 grade cattle, and 89 sheep and lambs. The animals were successfully wintered on native forage, supplemented by a small amount of purchased grain feed. The cattle secured sufficient grass to keep them in good condition until late in November, after which they were given a half ration of hay until December, 1911. From that time until April 15 they were regularly fed silage and hay until May 9, when the supply of grass was again adequate. The sheep wintered well and were in good, thrifty condition in the spring. When sheared in June the fleeces of ewes averaged 7 pounds of clean wool of good quality.

Arrangements were begun to take up dairying as a part of the work at Kodiak. Over 100 tons of native grass hay and 170 tons of silage were put up during the past year.

Cooperative work by the Alaska stations with farmers and gardeners throughout the Territory was continued, and this work aided considerably in testing the value of different kinds and varieties of field and garden crops in different localities and under varying conditions.

The only publication of the station for 1911 was the annual report.

The income of the station during the past fiscal year was as follows:

United States appropriation-----	\$28,000.00
Sales and other funds-----	3,807.86
Total-----	31,807.86

The work of the Alaska stations was eminently successful during the past year. All of the stations are growing in the esteem and favor of the people for whom they are maintained, and the result of their work is of international interest.

ARIZONA.

Agricultural Experiment Station of the University of Arizona, Tucson.

Department of the University of Arizona.

R. H. FORBES, M. S., *Director.*

The Arizona station continued its work during the past year along the same general lines pursued the year before. Several important phases of the experiments in hand were brought to completion and the results were either reported upon or prepared for publication. Few changes were made in the station staff and there were no additions to the number employed the previous year.

General progress was made in the Adams fund work. A bulletin was published summarizing the results obtained up to date in the study of the chemical composition and transformation as related to the process of ripening in dates. Two methods of ripening this fruit artificially have been developed, and it is believed that both are entirely practical. It is pointed out that two distinct chemical varieties of dates exist, the invert sugar and cane-sugar types, and that these are determined by the presence or relative absence of invertase. Dates can not be artificially ripened into an economic product until a certain minimum accumulation of sugar in the fruit has taken place. Premature ripening may be induced artificially in certain varieties by the action of various chemicals, acetic acid being the best in most cases, and also by killing the protoplasm through heat. The Deglet Noor date, generally considered a standard of excellence, does not mature satisfactorily under the climatic conditions of Arizona, but conditions favorable for the rapid ripening of this and other varie-

ties may be produced artificially in an oven by regulating the degree of moisture and temperature.

Studies of the culture and nutritive value of cactus were completed during the year, and while the results of digestion experiments with sheep indicated a comparatively low nutritive value, cacti seem to have an emergency value as forage which is well worthy of consideration.

In the study of the toxic effects of copper compounds on crops, special attention was given to the specific physiological action of copper salts in culture solutions. The work has been accepted as a basis for the adjudication of claims for damages from irrigation water polluted with copper-mine washings. A report on the work to date is being prepared.

The investigations on the ground-water supply in relation to irrigation, conducted in the Sulphur Springs Valley, partly in cooperation with the United States Geological Survey, were continued along the same lines and with the same detail as was done in the Rillito Valley, where this same line of work was closed out and reported upon last year.

The plant-breeding work with alfalfa was narrowed down to four strains, studied especially with reference to leafiness and yield. A study was also made of the correlation of external characters and nitrogen content.

Under the Hatch fund the agronomist conducted experiments in dry farming at two different points in the State, with encouraging results only where supplementary irrigation was available. In conjunction with this work frijoles, Indian beans, milo maize, and sorghum were grown on light and heavy soil, and the moisture conditions of the soil were studied. A large number of regional varieties of alfalfa were under test, partly in connection with the breeding work already mentioned. Some work was in progress along the line of growing sugar beets for seed.

The botanist continued observations on the distribution of native species of plants and on the limits of adaptability of introduced species. A bulletin bringing together many of the results of this work and suggesting their application to the solution of the grazing and other range problems of the State was published during the year. Some of this work was carried on in cooperation with this department.

The horticultural work in progress includes the culture of date-palm crosses and of citrus and deciduous fruits. Twenty varieties of olives recently brought from North Africa were planted and observations were made on 84 varieties of grapes in a vineyard set out three years ago and now in a flourishing condition.

The experiments in crossing Tunis on native sheep have involved about 800 head up to date, and the flock at the station farm at the close of the past year consisted of 350 sheep. A number of crosses now in the third generation are showing good wool and mutton quality. The dominance of Tunis characters is very evident in these crosses.

The experimental farm of about 8 acres near Yuma is a demonstration of intensive farming and is supported by State funds. The crops tested include several varieties of wheat, alfalfa, sugar beets, sweet potatoes, cabbage, asparagus, onions, melons, and dates.

The cooperative extension and farmers' institute work of the station was in general supported and carried on in the same manner as heretofore.

The following publications were received from this station during the year: Bulletin 64, Ground-water Supply and Irrigation in the Rillito Valley; 65, The Grazing Ranges of Arizona; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Balance from previous year, State appropriation-----	7,183.07
El Paso & Southwestern Railroad, including balance from previous year -----	3,267.44
Farm products-----	2,529.57
Total-----	42,980.08

The Arizona station is thoroughly investigating a number of problems of prime importance to the agriculture of the State, and several of these lines of work have reached a stage of development in which the results are ready for application in agricultural practice.

ARKANSAS.

Arkansas Agricultural Experiment Station, Fayetteville.

Department of the University of Arkansas.

C. F. ADAMS, B. Agr., A. M., M. D., *Director.*

A number of changes occurred in the staff of the Arkansas station during the year, and although to some extent interrupted by these changes the work progressed along definite lines.

The Adams fund projects were continued and progress in them was made. A project on the cattle tick was concluded, but some further work was done on the life history of the tick. The virulence of ticks, the methods of infection, and other factors in distributing the disease were investigated, together with the relation of hog-cholera and swine-plague bacilli to diseases of hogs.

Work on the apple-twig blight as originally outlined was about concluded and the data were worked up for publication. Marked differences in the susceptibility of varieties were noted, and the influence of proper soil and fertilizer treatment in the control of the disease was observed. Work was begun on the determination of factors of immunity in certain varieties. Studies were made of the causal organism and of the chemical changes brought about in diseased twigs.

In connection with the study of losses in soil fertility in fruit growing a large amount of analytical data was accumulated during the year. Work on the toxic substances in cottonseed meal was pursued, and studies on the woolly aphid and the apple-tree borer were continued. Progress was also made in cotton-breeding work and the study of the transmissible characters in cotton.

The work conducted with the Hatch and other funds of the station was extensive and varied, and part was taken in it by all the different departments. The department of entomology studied methods for the control of the San José scale, codling moth, plum curculio on apples, black aphid of the peach, cotton-boll weevil, and other insects. A new borer was found and its life history is being worked out. The results of spraying work were reported upon in Bulletin 107 of the station.

The plant pathologist investigated the bacterial flora of apples, plums, and other fruits in relation to disease production, and entered upon work on rice blight.

The chemist cooperated with other departments, doing a great deal of analytical work in connection with a number of projects and including numerous analyses of feeds and soils.

In agronomy special attention was given to cotton and corn, the experiments conducted including tests of varieties, dates and methods of planting, cultivation, the use of fertilizers, and similar cultural problems. Similar work was carried on with wheat, oats, barley, rye, forage plants, including grasses, clovers, alfalfa, soy beans, cowpeas, and other crops. Work was also carried on with sorghum, Kafir corn, beggarweed, velvet beans, and other similar plants to determine their adaptability to Arkansas conditions.

The department of horticulture brought together a lot of data on various fruits and vegetables, carried on experiments with asparagus, rhubarb, potatoes, tomatoes, strawberries, and orchard cover crops, and tested in cooperation with this department the value of Hungarian apple stocks. Experiments were also conducted in orchard heating for the prevention of frost and work was begun with walnuts and pecans. In addition a large amount of material secured from this department was given trial.

The department of animal husbandry took up work in feeding rice bran and rice polish to bacon and lard types of pigs to ascertain the value of the feed and possible differences due to type. Along dairy lines, records on feeding, milk production, quality of milk, etc., were kept of the station herd to determine the cost of milk production.

The veterinary department inaugurated work on glanders, prepared and distributed serum under the State law, and continued its work on the eradication of the cattle tick. The results of its work with glanders indicated that the serum test is reliable.

The extension and farmers' institute work is supported by special State appropriations and is conducted by the college, the station assisting only in an incidental way.

The following publications were received from this station during the year: Bulletin 106, Live Stock Sanitary Laws of the State of Arkansas; Circulars 1, Corn Judging; 2, Farmers' Handbook on Swine; 3, Corn and Cotton; 4, How to Control the Two Worst Cotton Pests, the Boll Weevil and the Bollworm; 5, Spanish Peanuts, Dwarf Essex Rape, and Cowpeas for Swine; 6, Farm Butter Making; 7, How to Control the Scab and Blotch of the Apple; 8, Does Better Cotton Seed Pay; 9, Suggestions on Commercial Muskmelon Growing; and 12, Hog Cholera and State Vaccination.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Balance from previous year, State appropriation-----	14,178.95
Farm products, including balance from previous year-----	5,506.89
Miscellaneous-----	3,342.06
Total-----	53,027.90

The work of the Arkansas station has been interrupted to some extent by frequent changes on the staff, but its present organization promises progress in the different lines of investigation followed. The station is greatly in need of an adequate area of suitable land for its operations.

CALIFORNIA.

Agricultural Experiment Station of the University of California, Berkeley.

E. J. WICKSON, M. A., Director.

As in previous years, the work of the California Experiment Station was extensive and varied, much of it being carried on with the aid of State appropriations. Insecticide-control work is put by law under the station, and a State appropriation of \$5,000 annually was made for the work. An insecticide laboratory was fitted up during the year, and a hog-cholera serum laboratory was also provided.

Progress was made in the Adams fund work of the station, and some of the projects were brought to a close. The study of the relation of marly soils and of lime to chlorosis of citrus fruits was continued with the addition of bacteriological studies of soils.

In the work on artificial immunization of cattle against tuberculosis the testing of bovovaccine was completed. The vaccine failed to immunize longer than three years, and the amount of protection for two and one-half years was about 50 per cent. Three papers have been published on this line of work.

The investigation on the control of the scales attacking citrus trees was continued, and in this connection an apparatus for making determinations with reference to the necessary strength of cyanid of potassium needed according to the size of the tree, the fabric of the tent, leakage, etc., was devised. Studies were included on the conditions governing the destruction of the scale egg, and much work was in progress in both field and laboratory.

Digestion experiments with poultry were made with different grains and concentrated feeds in various combinations. A considerable amount of data has accumulated in these experiments and is awaiting publication.

The study on the influence of environment on the gluten content of grain received a great deal of attention, and two bulletins based upon this work were published. A comprehensive study was made of the California white wheats, and a report on their chemical composition, including their gluten content and their value for milling and baking purposes, together with a progress report upon soil and climatic factors influencing the composition of wheat, was published.

Work on the nature of certain physiological plant diseases was carried on at Whittier, several physiological troubles of citrus trees being under investigation. A report on the gum disease of citrus fruits was made sometime ago. A special study was made of the relation of soil conditions and of the general influence of heredity and environment.

The investigation on the sterility of almond trees was continued, and the results secured were confirmatory of previous data. It has been found that the pollen is very largely defective and that there is comparatively little self-fertilization.

Progress was made in the work on walnut-oak hybrids, a considerable number of pollinations have been made, and a number of hybrids obtained. Brief reports covering part of this work were prepared. The work on Nicotiana hybrids was practically brought to completion and awaits the preparation of the report.

A number of different lines of work carried on with Hatch and other funds were conducted in different parts of the State. At Davis, variety and breeding experiments with cereals were in progress, and

work with alfalfa, cowpeas, peas, and vetches was carried on at Davis, Kearney, and in the Imperial Valley.

Experiments with Lima beans were conducted in Ventura County, and in the Imperial Valley experiments with cotton were continued. The station Bulletin 211, How to Increase the Yield of Wheat in California, was well received, and its recommendations in some instances have found application on a large scale.

An experiment with 240 varieties of grapes was conducted on 10 acres at Davis, and another 10 acres was devoted to experiments with different stocks, with a view to finding stocks resistant to phylloxera. In the Imperial Valley about 50 varieties of table grapes were grown. It was found there that the Persian varieties tested were very early, ship well, and in general gave good results. The little leaf disease of grapes, prevalent in certain parts of the State and occurring on all types of soil, was studied, and different treatments were tried for its control. Laboratory work on wine making was continued, and an effort was made to get California wine makers to adopt methods as already worked out in Europe. The horticultural work at Davis included tests of varieties of peaches, almonds, apricots, figs, prunes, and other fruits, together with trials of tomatoes and onions. Of tomatoes 270 varieties and strains were grown, and breeding experiments were made to eliminate uneven ripening and other defects. With onions, fertilizer experiments and work on the improvement of seed were in progress. One of the objects of breeding work with onions was to get good size to meet market requirements. In connection with this work on tomatoes and onions studies were made of the tomato worm and of onion mildew, and attention was also given to methods for combating them. Experimental work was also carried on with lettuce, turnips, peas, and other truck crops.

The station's work in vegetable pathology included studies of olive knot and root rot of walnuts, oranges, and other trees. A general bulletin on plant diseases in California was recently published.

Irrigation experiments in cooperation with this office on the duty of water for alfalfa and grain, evaporation, cost of pumping versus ditch irrigation, and on the comparative efficiency of weirs and orifices were systematically conducted at Davis.

Work in progress in the southern part of the State included fertilizer experiments with citrus fruits, tests of cover crops in orchards and in pots, and a study of the nitrogen-collecting power of different leguminous plants at Riverside and the improvement of walnuts and citrus fruits, together with the culture of hay crops on the sewage farm at Pasadena.

The entomological department of the station studied the honey plants of California, citrus-fruit insects, the house fly in its relation to public health, the black and the red orange scale, and the peach-tree

borer, and prepared reports on these different lines of work. Tests were also made of spray nozzles, and work on devising new forms of nozzles was pursued.

The following publications were received from this station during the year: Bulletins 206, Commercial Fertilizers; 207, The Control of the Argentine Ant; 208, The Late Blight of Celery; 209, The Cream Supply; 210, Imperial Valley Settlers' Crop Manual; 211, How to Increase the Yield of Wheat in California; Circulars 52, Information for Students Concerning the College of Agriculture of the University of California; 53, Announcement of Farmers' Short Courses for 1910; 54, Some Creamery Problems and Tests; 55, Farmers' Institutes and University Extension in Agriculture; 56, Worthless Fertilizers; 57, Announcement of Farmers' Short Courses in Animal Industry and Veterinary Science at the University Farm, Davis, California; 58, Experiments with Plants and Soils in Laboratory, Garden, and Field; and 59, Tree Growing in the Public Schools.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000
United States appropriation, Adams Act-----	15,000
State appropriation-----	69,750
Sales-----	1,000
Miscellaneous-----	12,500
Fees-----	10,000
Total -----	123,250

The California station carries on a relatively large amount of work, with the aid of State appropriations, and is covering more fully than heretofore the various agricultural regions and industries of the State.

COLORADO.

Agricultural Experiment Station, Fort Collins.

Department of the State Agricultural College of Colorado.

C. P. GILLETTE, M. S., Director.

Improvements at the Colorado station during the year comprised a material increase in equipment for irrigation investigations, work with poultry, and feeding experiments with cattle and swine. For the current biennium the State legislature appropriated for experimental and extension work a total of \$45,000, divided as follows: Animal husbandry, \$7,500; fruit investigations, \$6,000; agronomy, \$5,000; potato investigations, \$5,500; poultry investigations, \$5,000; horse breeding, \$5,000; dry-farming investigations, \$3,500; irrigation and drainage, \$5,000; and veterinary work, \$2,500. During the year

V. M. Cone, formerly connected with the irrigation investigations of this office, was appointed irrigation engineer.

Under the Adams fund, work on new irrigation projects was begun and new devices and apparatus were installed to facilitate and expedite the work in the field and in the laboratory.

Investigations on the occurrence of excessive amounts of nitrates in Colorado soils and their effects on plants, especially orchard plants and sugar beets, were actively pursued and the third bulletin on this line of work was published. The area of actual destruction of crops examined included 300 to 400 acres. Among the soils examined some contained as high as 6.54 per cent of sodium nitrate. The rate of fixation of nitrogen in these soils was found to be very high and further evidence, pointing to the fact that the excess of nitrates is due to phenomenal bacterial activity, was secured. The bacteriologist determined a large number of very active forms of Azotobacter having a pronounced power of brown pigmentation in the presence of nitrates from these soils.

The investigations on hold-over blight in pear and apple trees were completed, and work was continued on the causes of raspberry yellows, and incidentally on tests of sprays as remedial agents. The investigations on a bacterial disease of alfalfa were also completed, but observations on the blight resistance of 84 varieties of alfalfa growing at Rocky Ford were continued.

The department of entomology carried forward its studies of plant louse life histories, and published several papers on the data secured during the year.

With Hatch and State funds the agronomist continued work on improvement of wheat, study of rotations in cooperation with farmers in different parts of the State, and tests of forage crops suited to Colorado conditions. Experiments were also continued on the culture of crops suited to high altitudes, and a preliminary report on these experiments was prepared. Much attention was given to selection and breeding and the correlation of characters of field crops, particularly grains and alfalfa. The work with alfalfa was quite extensive and consisted of collecting, testing, and distributing improved strains and breeding for frost, drought, and blight resistance. Promising strains of alfalfa were discovered, and these were tested with other promising varieties in different parts of the State. Important data were also secured with reference to the relation of root growth and stooling habit to drought and cold resistance. In addition to this work, considerable attention was given to the study of varieties, adaptation, and methods of culture of the field pea, and to tests of methods of preparing new land. A grass garden was started at the station during the year, and cooperation with this department in testing varieties of sugar beets was continued.

The lines of work pursued by the horticulturist, mainly with State funds, included observations on the culture, storage, and diseases of potatoes, a study of the possibility of establishing more hardy strains of apples, experiments with celery, asparagus, and cabbage, tests of cover crops for orchards, and comparisons of horticultural rotations. Some study was made of the milder flavor of high-altitude vegetables and fruits, and experiments with different vegetables and fruits were begun at high altitude at Fort Lewis.

The animal-husbandry work was also largely supported by State funds and included comparison of rations, especially those containing alfalfa, ground and unground, and molasses for cattle, sheep, and hogs. California feed barley was compared with corn in combination with alfalfa in rations for steers and sheep. Experiments in crossing hogs and in breeding up the dairy herd were in progress. No experimental work with poultry was done, but equipment and stock were improved, and 12 demonstration breeding plants in different parts of the State were established. The station cooperated with this department in the study of dairying in the State and in horse breeding as in previous years. In the horse-breeding work the animals in the stud now number 84, but 14 of these were condemned as not conforming to the type desired.

In addition to its Adams fund work on plant lice the department of entomology studied methods of repression of grasshoppers and of foul brood of bees. The work on bees was connected with the duties of the head of the department in the capacity of State entomologist.

The irrigation engineer took up work on the studies of pump irrigation, of concrete structures for canals and ditches, evaporation experiments to determine the law of the effect of wind velocity, humidity, temperature of both air and water on evaporation from water surfaces, and to derive a formula for ready calculation of evaporation losses. In this connection a record is made of meteorological facts, especially those relating to agricultural meteorology, humidity, precipitation, temperature, soil temperature, solar radiation, sunshine, direction and velocity of the wind, evaporation from water surfaces, etc. A bulletin giving the results of 25 years of meteorological observations at the station and the results of evaporation experiments is soon to be published. Cooperation was carried on in rather extensive experiments for the purpose of determining water supplies in the subsoil, and the practicability of using this water by means of large pumping plants for the irrigation of the land above it. The experiment also included the duty of water.

The botanist continued experiments on the destruction of dandelions in lawns, made observations on the relation of seasonal conditions to plant growth, and engaged in cooperative tree planting of black locust and hardy catalpa with State funds.

The following publications were received from this station during the year: Bulletins 156, Butter Making—Clean Milk and Commercial Starters; 157, Arsenical Poisoning of Fruit Trees; 158, A Bacterial Disease of Alfalfa; 159, A New Alfalfa Disease—Stem Blight; 160, Nitrates in the Soil; 161, Cement and Concrete Fence Posts; 162, Rabies; 163, Farm Butter Making; 164, Poultry Raising; 165, Ration Experiments with Swine, 1906–1908; 166, Information Concerning the Colorado Carriage Horse-breeding Station; 167, Life and Care of Farm Machinery in Colorado; 175, The Potato Industry of Colorado—Potato Insects; 176, Productiveness and Degeneracy of the Irish Potato; Circulars 7, Milo; 8, Growing Potatoes in Colorado; 9, Growing Broom Corn in Colorado; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	-----	\$14,755.58
United States appropriation, Adams Act	-----	13,882.71
Balance from United States appropriation, Hatch fund	-----	244.42
Balance from United States appropriation, Adams fund	-----	1,117.29
Balance from previous year, State appropriation	-----	21,294.81
Miscellaneous	-----	23,129.61
Total	-----	74,424.42

The Colorado station has in progress a large amount of valuable work, with a view to solving certain problems of great significance to practical farmers and of much scientific interest.

CONNECTICUT.

The Connecticut Agricultural Experiment Station, New Haven.

E. H. JENKINS, Ph. D., *Director.*

The Connecticut station in January, 1911, acquired a tract of 20 acres of land and began putting it into shape for plat work. The land was cleared and fenced, a small peach and apple orchard was planted, and an experiment on soil treatment was begun. A part of the tobacco work and nearly all of the work with corn was conducted on this tract.

The legislature of 1911 made the same regular appropriations to the station as for the preceding biennial period. These include \$10,000 for general support, \$2,500 a year for food work, and \$3,000 a year for the State entomologist. A special appropriation of \$10,000 was made for combating the gipsy moth if necessity for this should arise and \$6,500 was allowed to meet the fire loss on the laboratory building two years ago.

Under the Adams fund the study on the nutritive effect and value of vegetable proteids was continued with the assistance of the grant for this work from the Carnegie Institution. Considerable difference

was observed in the different proteids. Some of them sustained life but did not produce growth, while others producing growth to a certain extent had nevertheless a stunting effect. None of the proteids tried thus far would, if fed alone, produce normal growth. The results of the first year's experiments were published by the Carnegie Institution of Washington, and those more recently obtained were prepared for publication. Studies on the improvement of existing methods for determining the proportion of the various amino acids yielded by hydrolyzing proteids were continued, and the results obtained published in scientific journals. In addition to this work the study of the proteins of maize was begun and data of importance were secured concerning proteins of some other seeds.

The plant-breeding investigations included a continuation of the study of the physiology of inheritance of important seed and plant characters in maize. The study of the inheritance of seed characters was in the main completed, and the study of the plant characters yielded much of importance from a theoretical standpoint. The biometrical work pursued for the purpose of determining the increased vigor due to crossing nearly related strains of *Nicotiana tabacum* was about completed. The second generation of two tobacco crosses was grown to determine the method of inheritance of plant characters and also as a check upon the analysis of the Sumatra-Habana cross, which resulted in the production of the Halladay variety. The investigations in plant breeding with the potato were closed out.

A number of lines of work were carried on under the Hatch and other funds. The entomologist of the station in cooperation with this department, and under a State appropriation, continued his work on the gipsy moth. The colony of the insects at Stonington, which was cleaned up last year, showed no moths this season. Attention was also given to the study of the 17-year locust, the sawfly attacking the blackberry, and the pyralid moth found on Japanese barberry. Much of the time of this department is taken up by inspection and control work, including apiary inspection and the inspection of nursery stock brought into the State.

The entomologist and the botanist jointly carried on spraying experiments in 11 orchards located in different parts of the State and in cooperation with their owners to determine the relative value of summer sprays on apples and peaches.

The botanist further made observations on the effect of spraying with Bordeaux mixture in a dry season in combating potato blight. Life-history studies of the disease were also pursued. The work on the calico disease of tobacco was carried forward, and the observations on peach yellows were continued. It was found that in summer spraying for peaches self-boiled lime-sulphur and commercial sulphur preparations may be substituted for Bordeaux mixture,

which has caused much injury to the fruit. A test of the effects of different methods of fertilizing on the growth, fruit production, prevalence of winter injury, and the prevalence of yellows in an orchard of 900 peach trees entered upon its third year. Attention was also given to melon culture, with special reference to the diseases attacking the crop. Chestnut blight, which is spreading in the State, was studied with regard to its distribution and the methods of its prevention and eradication.

The experimental forest planting with native and introduced species was continued in the station forest at Windsor. The thinning experiment in a white-pine plantation entered upon its third year, and of two experiments in thinning deciduous forests one was in its sixth and the other in its second year. The forester also examined lands for farmers, giving advice as to forest planting and management, and furnished at cost suitable stock for forest planting. He further brought about a greater efficiency in the system of forest-fire control in the State by securing legislation making cooperation between the fire wardens of adjoining towns possible. He cooperated with the Department of Agriculture, as provided in the Appalachian Forest Reserve act for fire protection of forests on the watersheds of navigable rivers. Under an arrangement with the Forest Service, work was begun on a cooperative study of woodworking industries in Connecticut, with special reference to closer utilization of forest products. A practical result of this work in forestry has been a stimulation of interest in forest planting on nonagricultural lands.

Laboratory and vegetation tests on the availability of nitrogenous manures produced by the chemical treatment of inert materials like leather, hair, etc., have been completed and the results prepared for publication. The general indications are that some forms of nitrogenous matter recognized to be of no immediate value as fertilizers can be converted by relatively inexpensive chemical treatment into fairly available forms, and that chemical methods can determine with more accuracy than heretofore whether organic nitrogen of commercial fertilizers is or is not fairly available to crops.

The station carried out jointly with this department experiments on the effect of phosphates on the quality and quantity of the tobacco crop. A bulletin was published during the year reporting the results of similarly arranged cooperative work with reference to the advantage of sterilizing tobacco-seed beds and describing the apparatus for and the operation of steam sterilizing.

The principal form of extension work by the station consisted of an exhibition illustrative of the different departments of its work in a tent, 40 by 60 feet, which was set up at six agricultural fairs in different parts of the State. Members of the staff were in attendance

to explain the exhibit and answer questions. This has been found to be a very profitable form of extension work and better adapted to the State than the instruction trains.

The following publications were received from this station during the year: Bulletins 166, The Management of Tobacco Seed Beds; 167, Inheritance in Maize; 168, Improvement in Corn; and the Annual Report for 1909-10, parts 5, Fertilizers, 1910; 6, Food Products and Drugs, 1910; 7, Tests of Summer Sprays on Apples and Peaches; 8, Commercial Feeding Stuffs, 1910; 9, Tenth Report of the State Entomologist, 1910; 10, Report of the Station Botanist, 1909-10; and 11, Report of the State Forester, 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$7,500.00
United States appropriation, Adams Act-----	7,500.00
State appropriation-----	19,650.00
Individuals-----	17,367.65
Fees, including balance from previous year-----	11,217.95
Farm products-----	87.79
Miscellaneous -----	39.21
Total-----	63,362.60

The Connecticut station is pursuing a number of important lines of investigation and is successfully meeting many of the needs of the farmers of the State.

Storrs Agricultural Experiment Station, Storrs.

Department of the Connecticut Agricultural College.

L. A. CLINTON, M. S., *Director.*

No changes were made in the lines of work or in the personnel of the station during the past year.

No new lines of the Adams fund work were taken up, but the different projects were actively carried forward. Considerable work was done on the project in soil biology, special studies being made of the bacteria in frozen soils, the bacterial content of soils as affected by culture, grass-sod, and other conditions, and the relation of bacteria to the growth of alfalfa. Bacteria were found to be very abundant in frozen soils.

A second report was published during the year on the investigation of bacillary white diarrhea of young chicks carried on in cooperation with Dr. L. F. Rettger, of Yale University. This report discussed the cause of the disease and the source of the germ, and pointed out the progress made toward controlling and stamping out the disease.

The cheese investigations, conducted in cooperation with this department, were steadily pursued on the same basis as heretofore. Special attention was given the past season to the Roquefort type of cheese. In the study of silage fermentation, special consideration was given to silage bacteria and to temperature changes taking place in the silo, especially in the interior of the mass of silage.

Among the work carried on by the horticultural department under the Hatch and other funds was the closing out of a nine-year period of spraying experiments with cucumbers and melons. This department published a systematic description of New England trees, in the form of Bulletin 69 of the station, paid for from State funds. The extension work in horticulture, carried on as heretofore for the college, included demonstrations of methods of orchard management in different sections of the State.

In dairy husbandry, as in the previous year, attention was given to the cost of raising and maintaining dairy cattle; and a feeding experiment with high and low protein rations in its second year was continued with 10 cows. The effect of these rations on vigor, productiveness, and fertility was studied. The ice-cream studies, under way last year, were also continued.

Preparations were made for testing, on a rather large scale, the comparative egg-laying capacity of different breeds of chickens. The State Game Commission began experiments in raising quail at the college. The birds were kept under close observation, especially with reference to their egg production, and the problems of hatching the eggs and keeping the birds free from disease received considerable attention.

The following publications of the station were received during the year: Bulletins 64, Connecticut Weather Review; 65, Butter Making on the Farm; 66, Apple Growing in New England—IV, Orchard Management; 67, Water Glass and Preservative for Eggs; and 68, Bacillary White Diarrhea of Young Chicks.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$7,500.00
United States appropriation, Adams Act-----	7,500.00
State appropriation, including balance from previous	
year -----	2,435.83
Miscellaneous, including balance from previous year-----	754.89
Total-----	18,190.72

The affairs of the Storrs station are in good condition, and many of its lines of work seem to be actively prosecuted and quite scientific and fundamental in character.

DELAWARE.

The Delaware College Agricultural Experiment Station, Newark.

Department of Delaware College.

H. HAYWARD, M. S. Agr., *Director.*

Changes on the staff of the Delaware station during the past year were practically confined to the addition of two extension assistants, one, M. O. Pence, in agronomy, and the other, W. C. Pelton, in horticulture. After the close of the fiscal year C. F. Dawson, the veterinarian, was succeeded by R. C. Reed, and M. T. Cook, the plant pathologist, resigned to accept a like position at the New Jersey station. The farm equipment of the station has recently been greatly improved with State appropriations for the purpose.

Satisfactory progress was made during the year in several of the Adams fund projects. The results of a study of the toxicity of tannin, in the project on the relation of fungus parasites to the cell contents of the host plants, was reported. This study showed that tannin exerts a marked influence in inhibiting germination and killing spores of parasitic fungi. While its effect in this respect was found variable, the majority of parasites used in the experiments were retarded by 0.1 to 0.6 per cent of tannin. Fusariums were found more resistant than Gloeosporiums and Colletotrichums, and the Cladosporiums were more resistant than the Fusariums. *Penicillium olivaceum* was the most resistant of any species used. It was further found that low percentages of tannin may stimulate germination.

The past year was the third in which studies were conducted on the response in different ways of various types of wheat to different kinds and quantities of plant food, and the work was about completed. A large amount of data has been secured with indications of several marked relationships. Preliminary work was done on an investigation of the effect of different variations in the corn kernel upon the plant. Considerable attention was given to the perfecting and simplifying of special chemical methods required in work on projects in agronomy and plant pathology.

Studies on the double-blossom disease of the dewberry were closed out and the results reported in Bulletin 93 of the station. Many points in the life history of *Fusarium rubi*, the cause of the disease and its methods of attack were brought out. Picking the diseased buds just as they opened was found to be an efficient method of control.

Studies on the relation of lime to the organic matter of the soil were continued, in cooperation with the station chemist, in a series of bell jars and in field experiments. The investigation on in-and-in breeding of pigs made good progress, but was interfered with to a considerable extent by cholera.

The veterinarian published during the year the results secured in the study of anthrax carried on in cooperation with this department during the last three years. As stated in Bulletin 90 of the station, he has produced an antibacterial serum by highly immunizing sheep by repeated inoculations, first of attenuated anthrax bacilli, and following these by inoculations of the most virulent races of the bacilli in increasing doses until the animal would withstand 50,000 times the minimal lethal dose with impunity. It is further pointed out that the serum will confer a passive immunity immediately and thus protect the animal against fatal infection over the period which is necessary for the vaccine to confer an active immunity.

This bulletin also reports observations on the efficacy of vaccines carried on for two seasons, which indicate that the anthrax vaccine will remain active for several months, and that such cultures may be prepared several months in advance of their use provided incubation is carried to a point where all growth ceases or spores form. The veterinary research work during the past year also included some preliminary work on cerebrospinal meningitis of the horse.

With the Hatch fund experiments were made with fertilizers and cover crops for peaches and apples, fertilizers for tomatoes and potatoes in relation to their effect on the yield and quality, varieties of fruits and vegetables, lime and manure in rotation experiments with corn, wheat, oats, and grass, and varieties of corn, wheat, oats, cow-peas, soy beans, and other crops. A new series of 1, 2, 3, and 4 year rotation experiments to emphasize the importance of green manures was started during the year.

The station carried on no cooperative work other than that conducted in connection with extension work. For the present biennium an annual State appropriation of \$4,500 is available for extension purposes. This work is mainly done by station officers and consists largely in cooperative experiments.

The publications received from the station during the year were as follows: Bulletins 89, Crimson Clover Culture; 90, Anthrax; 91, The Relation of Parasitic Fungi to the Contents of the Cells of the Host Plants—I, The Toxicity of Tannin; 92, Annual Report of the Director for 1910; and 93, The Double Blossom of the Dewberry.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation-----	5,000.00
Farm products-----	1,988.40
Total-----	36,988.40

The improvement of the equipment and work of the Delaware station is steady and substantial, and the scientific and practical value

of the output increases each year. The station now has a creditable farm equipment, but is still handicapped by lack of sufficient funds and laboratory room and facilities.

FLORIDA.

Agricultural Experiment Station of Florida, Gainesville.

Department of the University of the State of Florida.

P. H. Rolfs, M. S., Director.

There were no changes on the staff of the Florida station during the past year, but since its close E. W. Berger, who resigned as station entomologist to become State inspector of nursery stock, was succeeded by J. R. Watson; Mrs. E. W. Berger was succeeded by W. Voorhees as librarian, and O. F. Burger was appointed assistant plant pathologist.

Satisfactory progress in the Adams fund work of the station was made, and some of the results were published during the year. The plant pathologist reported considerable progress in the study of the scaly bark disease of citrus trees in Bulletin 106 of the station. The fungus *Cladosporium herbarum citricolum* was isolated repeatedly from diseased spots, and when inoculated into sweet orange trees was found to produce the early stages of the disease. Constantly associated with this fungus was the wither-tip fungus (*Colletotrichum glaeosporioides*), and this is considered an important secondary agent in the destruction produced by the disease. Heading back the orange trees during the dormant period and spraying five to six times with Bordeaux mixture or treating the bark or cut surfaces with carbolineum proved sufficient means for the control of this trouble. The spotting of the fruit was completely prevented by spraying with Bordeaux mixture.

Special attention was given the past season to the stem-end rot of citrus fruits. The causative organism had already been isolated and subsequent inoculation experiments showed the probable correctness of the conclusions relative to the cause of the disease. In connection with life-history studies it was ascertained that the fungus causing stem-end rot was in the orchard during practically the entire year, being found in partially decayed branches and twigs when the fruit was immature or not in the groves. Some shipping experiments in cooperation with this department were begun to determine the effect of the disease on marketed fruit. In connection with this work a second fungus capable of causing a very similar disease was discovered. Work on gummosis was continued and the organism *Diplodia natalensis* was found to be the causative agent. Through inoculation experiments it was determined that the disease is not

strictly limited to citrus trees. Work on other citrus diseases demonstrated that the scab of grapefruit, Satsuma oranges, and lemons is due to *Cladosporium citri*.

The chemist continued the study of soils and fertilizers in relation to the development and the growth of the orange tree begun near Tavares on Lake Harris. This field work comprises 48 plats with 10 trees per plat. Careful notes were taken as to the growth of the trees, the results of diseases affecting them, the fertilizer requirements, with special reference to the nitrates, forms of phosphates for citrus trees, etc. These field experiments on Lake Harris are supplemented by a study of trees grown under more perfect control in tanks at the station.

The studies on the white fly were continued, and life-history work on a second species was pursued. As a result of this research work, progress was made in the general management of white-fly infected orchards. It was observed that no one single method of combating the white fly will prove uniformly successful, but that the most economical and satisfactory method of handling the pest will be to combine the spray with insecticides with the spraying of fungus spores, and under certain conditions to fumigate the orchards. It was found that cultures of the fungi can be kept for at least seven months in cold storage, and in connection with this fact practical methods of growing the cultures were worked out, making it possible to have spore-bearing material for spraying at any time. Private parties in the State have taken up the spraying with fungus spores for white-fly control, and one concern sprayed 750,000 trees in 1910.

In the investigation on plant nutrition in relation to physiological diseases, important advances were made, special attention being given to the effect of different soils, methods of watering, and the character of fertilizers on melanose and die-back of citrus trees. In connection with this work, it was found that phosphorus is a means of correcting overfeeding with nitrogenous compounds, and that acid phosphate corrects the injurious effect of excessive applications of nitrate of soda.

In plant-breeding work attention was principally given to velvet beans and corn. An acre of the first generation of hybrid velvet and Lyon beans was under observation, together with an acre each of pure lines of these two plants. Careful records were made of color of flowers, dwarfing tendency, vigor, and other vegetative characters. Studies were pursued of the F₁ generation of corn hybrids, and line breeding was conducted with a number of varieties of corn introduced from Mexico, Central America, and elsewhere.

The Hatch fund work of the station in animal husbandry included feeding experiments with pigs, cattle-breeding experiments, determinations of the cost of milk production, and trials of various crops, Japanese cane and velvet beans were used in the feeding tests with

pigs. The cattle-breeding work was begun with grade Shorthorns, Herefords, and native stock, and two calves of each were under observation.

Results of the work in agronomy have demonstrated that Japanese cane is a very satisfactory forage plant. The Kudzu bean (*Pueraria thunbergiana*) did not prove satisfactory, as the plant did not recover well after cutting. Experiments were in progress in testing varieties of corn and cotton, together with plant-breeding experiments and breeding experiments for the improvement of these two crops in yield and quality. The station carried on cooperative work with the extension division of the college and with fruit growers in connection with several projects carried on to solve some of their difficulties. The director is the only officer of the station connected with the extension work, which is conducted principally by two officers engaged specially for that purpose. Occasional lectures on specific lines of investigation, however, were given during the year by station officers.

The publications received from the station during the year were as follows: Buletins 103, White-fly Control; 104, Pineapple Culture—VII, Nitrates in the Soil; 105, Japanese Cane for Forage; 106, Scaly Bark or Nail-head Rust of Citrus; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Fees -----	70.00
Farm products-----	709.96
Miscellaneous-----	18.27
Balance from previous year-----	555.85
<hr/>	
Total -----	31,354.08

The Florida station has in hand many problems peculiar to the State, and the institution may be regarded as having a field distinctly its own in which it pursues energetically and systematically the solution of questions concerning the farmer, truck grower, and orchardist.

GEORGIA.

Georgia Experiment Station, *Experiment*.¹

Department of Georgia State College of Agriculture and Mechanic Arts.

M. V. CALVIN, *Director*.

No important changes occurred at the Georgia station during the year in either the staff or the lines of work. The position of animal pathologist and veterinarian was abolished and the work combined with that in animal husbandry.

Some progress was reported upon most of the Adams fund projects. In the study of the effect of stable manure upon the bacterial flora of

¹ Telegraph, freight, and express address, *Griffin*.

soils particular attention was given to the distribution of soil bacteria and the rate at which ammonia and other nitrogenous compounds are transformed. The presence of manure was found to influence the total number of organisms present, but it did not affect the number of species found. Sterilized manure when added to soils in pots was found to increase the bacterial flora more than unsterilized manure. Very little difference was noticed in the rate of ammonification in the different pots in the series. Manured soils were found to nitrify better than soils receiving no manurial treatment, and it was concluded that either the nitrifying organisms are in the manure or that they act more freely in its presence. Life history and control studies of the plum wilt were continued.

In the study of Mendelian inheritance in the cotton plant about 30 characters in the F_1 generation of cotton hybrids were under observation. Of these hybrids about one-half acre was grown in 1910, and about 4 acres of the F_2 generation were planted in 1911. Tests were also made of the value of continuous selection of cotton plants for resistance to anthracnose. While thus far no complete immunity has been secured, selections were obtained in which the prevalence of anthracnose is very greatly reduced.

The veterinarian continued his work on tick fever, but with a very limited number of animals, conducting a test of trypanblue as a treatment. In addition to this work, a test of the action and efficiency of bacterin in treating fistula was made. A detailed report on the work to date was prepared.

In the grape-breeding project it was necessary to study the self-sterility of the Muscadine grapes. About 800 seedlings were grown to determine the prevalence of white and black fruited varieties and the causes giving rise to this difference in color.

The bacteriologist in cooperation with the horticulturist studied the relation of manure, insects, influence of variety, etc., to the occurrence of end rot in the tomato. Special attention was given in this connection to soil and atmospheric conditions, and particularly the moisture conditions of the soil and the atmosphere. The chemist completed two years' work on the effect of different compounds and amounts of nitrogen, potash, and phosphoric acid on the composition of the cotton plant, and prepared a bulletin giving the results obtained. Studies were in progress on the phosphorus content of the various parts of the cotton plant, with special reference to the seed.

The preliminary work on the protein requirements of growing cattle under 1 year of age showed that the capacity for growth depends primarily upon the individual, and that as long as the protein supply is adequate to furnish material for growth a larger quantity causes a greater rate of growth only to a minor degree.

Individuals apparently varied in their requirements for protein and a deficiency in this particular food constituent limited growth.

The project on the cotton red spider was completed during the year. Spraying experiments carried on in this connection pointed out that lime sulphur and sealecide solutions killed over 99 per cent of the spiders, as well as the eggs, without producing injurious effects upon the plant. Studies were also made during the year on the life history and means of control of the mole cricket. Several phases of the life history of this pest were worked out.

With the Hatch funds various field experiments with fruits and vegetables were continued, as were fertilizer and culture experiments with field crops. Two years' experiments in cabbage culture were brought to a close and a bulletin published. Late spring frosts injuriously affected the fig orchard and the peach crop.

In animal husbandry, work was done on pasturing dairy cows, feeding cottonseed meal, growing lespedeza for grazing, and breeding razorback hogs.

The following publications were received from this station during the year: Bulletins 90, Protein Requirements of Growing Cattle Under One Year of Age; 91, Cabbage Culture; 92, The Cotton Red Spider; 93, Corn Production; 94, Cotton Production; Circular 66, Variety Test of Cotton and Corn, 1910; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation -----	710.00
Farm products-----	4,553.33
Total-----	35,263.33

The Georgia station is conducted in an orderly way and is addressing itself to many of the practical questions of farming in the State.

GUAM.

Guam Agricultural Experiment Station.

Under the supervision of A. C. TRUE, Director, Office of Experiment Stations,
United States Department of Agriculture.

JOHN B. THOMPSON, B. S., *Special Agent in Charge.*

Much work was done at the Guam station in the construction of new buildings, building roads, clearing and draining lands, and making other improvements. The new office building was completed and occupied in the fall of 1910. A storehouse for farm implements was completed during the year, as was a stock barn 30 by 40 feet in extent. Considerable additions were made to the office equipment, and the beginning was made of a station library.

The leading investigation was the production of feed and forage preliminary to experiments on the improvement of the live stock on the island. Experiments with corn showed that the yield of Mexican June corn was heavier, the ears were filled better, and the grain deeper and less flinted than the native varieties, but in an experiment on keeping seed corn, the samples of Mexican June lost all ability to germinate, while a perfect stand from seed of native corn was obtained. Experiments with grasses showed the superior value of Para grass followed by *Paspalum dilatatum* and Guinea grass over all others tested. The production of forage from several of the nonsaccharine sorghums was fully demonstrated, and the culture tests of such leguminous plants as the pigeon pea, jack bean, and the common peanut gave promise of success.

Work with vegetables consisted of cultural tests with beets, patolas, radishes, carrots, onions, watermelons, muskmelons, cucumbers, lettuce, eggplants, cabbages, and tomatoes. Satisfactory results were obtained with all these crops with the exception of muskmelons, cabbages, and tomatoes.

One of the most striking achievements was the introduction of the Smooth Cayenne pineapple from Hawaii. The fruits produced were of excellent quality and many of them weighed as much as 10 pounds as compared with a maximum weight of 4 pounds for the native fruit. Avocado, orange, lemon, and pomelo trees made good growth, and trees of 10 varieties of Japanese persimmons were secured for trial in different parts of the island. Among other fruits introduced were Peen-to peaches, grapes, strawberries, and bananas. Ceara rubber, kola nut, camphor, hedge plants, and some ornamentals were also under test.

In animal husbandry experiments looking toward the improvement of the live stock of the island were begun. There were purchased for the station 6 head of Morgan horses, 4 of Ayrshire cattle, 4 of Berkshire hogs, and 8 each of Barred Plymouth Rock and Brown Leghorn chickens. With one exception all animals continued in a thriving condition in the new environment. The oldest bull died about two months after landing with symptoms of tick fever. This stock was fed almost exclusively on station-grown forage and grain.

The income of the station during the past fiscal year was as follows:

United States appropriation-----	\$15,000.00
Sales and other funds-----	35.74
Total-----	15,035.74

A growing interest in the work of the Guam station is noted. All requests for seeds and plants were granted as far as supplies were available, and instructions were given regarding their planting and care, every encouragement being offered to increase interest and

bring success to the planter. The cordial cooperation of the local authorities in furthering the station's work has aided materially in the attempt to improve the agricultural condition of the island.

HAWAII.

Hawaii Agricultural Experiment Station, Honolulu.

Under the supervision of A. C. TRUE, Director, Office of Experiment Stations,
United States Department of Agriculture.

E. V. WILCOX, Ph. D., *Special Agent in Charge.*

The new office building, provided for from Territorial funds and serving exclusively for the library, general office, and office of the entomologist, was occupied during the year. Quarters for the agronomist were provided in one portion of the old office building, which was completely remodeled to accommodate the work of the departments of chemistry and agronomy.

The portion of the ground turned over to the Department of Agriculture by the Navy Department, which is situated on Magazine Hill, was cleared and planted to corn, cotton, and broom corn, and considerable success was obtained with corn, particularly with the variety Yellow Creole. A portion of the upper slope of the station at an elevation of about 750 feet was cleared and planted to Caravonica cotton for comparing the growth of this variety at the higher and lower altitudes.

The investigations outlined in previous reports were continued and a number of new ones begun. A number of plantings of cotton were made from sea level to altitudes of 1,600 feet and the results obtained indicated that altitude alone did not determine success. It was also shown that the amount of rainfall necessary for good crop production has not been definitely determined. Pruning back the cotton plants at the close of each picking season and burning the rubbish was determined to be an effective means of controlling the Indian cotton bollworm. By this method the larvæ and pupæ of the bollworm on the infested bolls were destroyed and the pruning interrupted the crop of bolls as completely as a new planting where cotton is treated as an annual. The station has developed a peculiar type of Caravonica cotton in which the lint is unusually harsh and strong and apparently well suited for mixing with woolen goods. The quotation submitted by buyers and cotton graders on last year's crop was 40 cents for Sea Island, 28 cents for Sunflower, and 25 cents for Caravonica.

The Japanese rices imported by the station were successfully grown and satisfactory yields were obtained. The substitution of these rices for the imported article has not been fully satisfactory, some consumers claiming that they differ in certain undefinable qualities.

Fertilizer experiments with rice showed definitely that the application should be made before the rice is planted and that ammonium sulphate or an organic fertilizer is a better source of nitrogen than nitrate of soda. Fertilizer experiments with taro gave the same results as those with rice, and thorough drying and aeration of the soil between crops, together with proper fertilizing, was found to prevent taro rot.

The chemical investigations on manganese soils indicated that pineapple is exceptionally sensitive to unfavorable soil conditions and can not be made to thrive where from 4 to 5 per cent or more of manganese is present. It was found that the best results with pineapples on manganiferous soils can be obtained from planting the old stumps rather than the suckers, and by fertilizing heavily with phosphates. It appeared from an examination that improper drainage of soil is a conspicuous cause of some of the pineapple troubles in the district of Wahiawa. It was further determined that pineapples did not require as much water as has been formerly supposed and that with proper drainage they can be successfully grown under a heavy rainfall. Progress was made in accumulating data for a general classification of Hawaiian soils.

The most important feature of the entomological work during the year was the discovery of the Mediterranean fruit fly, which attacks peaches, all of the citrus fruits, mangoes, peppers, guavas, figs, and avocados. A plan devised by the station for the control of the pest consists essentially in the collection and destruction of fallen fruit. Studies were made of the insect pests of corn and leguminous plants, and attention was given to the subject of insect parasites, including a parasite destroying from 5 to 10 per cent of the bollworms.

The horticultural investigations were continued with tropical fruits. A budding method for the avocado was perfected and a successful inarching method was devised for rapidly testing promising seedlings. As far as possible, all types of avocados found in Hawaii have been collected and a system of classification and description is being worked out. Studies of papaya fruits showed that the variation in flavor, size, and shape is almost unlimited. The station found it possible to propagate papayas by the use of monoecious trees without the help of sterile male trees. Spraying experiments showed that the rusty blight of avocado leaves can be controlled with the use of Bordeaux mixture. The station gave assistance in the distribution of suckers of the Bluefields banana and in culture experiments. From the results of this work it seems evident that a wider spacing in planting should be adopted.

A number of miscellaneous investigations in progress included experiments with broom corn, leguminous forage crops, weed destruc-

tion with arsenite of soda as a spray solution, the utilization of the pulp from sisal mills, fiber in banana stalks and pineapple leaves, the production of oil from kukui nuts, etc.

Arrangements were made with private individuals and companies for cooperative experiments with fertilizers for different crops, the growing of sweet potatoes, corn culture, and other forms of diversified agriculture. During the past year under territorial funds the station established three demonstration farms, one on Kauai and two on Hawaii.

The publications of the Hawaii station during the past year were the Annual Report for 1910; Bulletins 22, Insects Attacking the Sweet Potato in Hawaii; 23, Leguminous Crops for Hawaii; 24, The Assimilation of Nitrogen by Rice; 25, The Avocado in Hawaii; Press Bulletins 28, Peanuts in Hawaii; 29, The Management of Pineapple Soils; 30, Killing Weeds with Arsenite of Soda; 31, Brief Instructions for Farm Butter Makers; and 32, Cultural Methods for Controlling the Cotton Bollworm.

The revenues of the station for the fiscal year ended June 30, 1911, were as follows:

United States appropriation-----	\$28,000.00
Sales and other funds-----	18,494.47
Total-----	46,494.47

The work of the Hawaii station is continuing to attract favorable attention and to create greater interest in the culture of a number of important crops adapted to the islands. This is notably true of its work with cotton, which seems to have demonstrated the profitability of growing the crop in Hawaii, and which enjoys the confidence of the planters, as shown by the increase in the acreage for commercial production.

IDAHO.

Agricultural Experiment Station of the University of Idaho, Moscow.

Department of the University of Idaho.

W. L. CARLYLE, M. S., *Director.*

The Idaho station made progress during the year in its various lines of work. The station staff was enlarged by the addition of a plant pathologist and assistants in bacteriology, horticulture, and animal husbandry. While the State made no direct appropriation for experimental work, an allowance of \$13,500 was made for the purchase of 120 acres of additional land adjoining the present experiment farm. The State also gave \$6,000 for the construction of modern and thoroughly equipped dairy barns.

Work was actively pursued during the past year on seven Adams fund projects. Studies on the gluten content of wheat were continued systematically along the same lines as reported last year. At Gooding, where a part of the work is carried on, studies were made of the effect of irrigation and methods of culture on the nitrogen in the soil and on the composition of wheat. In this connection three varieties of wheat were each grown on seven plats receiving different amounts of water. At Moscow the effects of fertilizer and rotation were studied in a similar way with different varieties of wheat, including some from Minnesota, Kansas, and Nebraska. A large amount of chemical work on wheat and wheat flour was done during the past year and baking and milling tests were brought to a conclusion.

The cooperative studies with this office on the duty of water in irrigation were continued at Gooding. The field experiments consisted of the application of different amounts of water at different times and by different methods in growing a number of field and garden crops. Evaporation experiments were conducted to strengthen the data secured in the field work.

The apple-breeding investigations included making 5,802 pollinations and placing 2,901 bags on trees. As a result of this work, 792 apples set, which gave an average of four seeds apiece. The question of self-sterility was studied, and 180 hybrids were grown from seed secured in 1910.

The bacteriological study of butter in relation to keeping was continued as originally outlined. In connection with the work on the effect of different factors on the bacterial flora of the product, about 150 different organisms have been identified. A large amount of data has been accumulated.

A study of the duty of water in plant growth was carried on by the agronomist under controlled conditions with some of the more important field crops. The plants were grown very successfully, and detailed records regarding their development were carefully kept. The agronomist also continued his work on the relation of calcium and magnesium in the growth of wheat.

Bacteriological studies of soil were conducted at the station and partly in connection with the duty of water studies at Gooding. Some work was also done with Azotobacter in soils of different regions.

With Hatch and other funds the agronomist conducted fertilizer experiments with wheat, oats, and corn; rotation experiments in eight series for the purpose of determining a system to do away with summer fallowing; made ear-to-row tests of corn; and compared varieties of wheat, barley, oats, corn, potatoes, peas, soy beans, sorghums, etc.

The dairy department gave special attention to methods of determining moisture and the amount of shrinkage in the storage and shipping of butter. Samples were kept in storage at the station for six or more months and shipped away and returned to the station, after which they were tested.

The horticulturist conducted experiments with tomatoes, onions, and muskmelons, including tests of varieties for their productivity and blight resistance; methods of pruning, training, and mulching; methods of packing the products, and determining the cost of production. Studies of summer and winter pruning of apples were made in an orchard planted in 1905. Bulletin 69 of the station, "The Farmer's Vegetable Garden," based on work done by the predecessor, including four years' work, was published during the year and the line of work was discontinued. The results of work with the strawberry were published in Bulletin 70 of the station and also discontinued.

In animal husbandry a feeding experiment was made with 40 pigs to test the value of soy-bean meal as compared with peas, tankage, or corn. Shorts and barley were used in all the rations and tankage gave the best results. Soy-bean meal was rather heavy for the animals and was best fed in small amounts. At Caldwell 300 lambs were fed in two lots, the one composed of fine-wool and the other of long-wool animals. This work was carried on for the purpose of determining on a commercial scale the proper time for taking animals off the range for systematic feeding.

The department of chemistry published Bulletin 68 of the station on the soils of the State. In addition to this work special studies were made of soils from Clagston and Caldwell, which involved a study of several types. Studies on the composition of fruit from irrigated and nonirrigated regions were completed and prepared for publication.

The station cooperated with the State substation at Clagston in determining the cost of clearing cut-over pine and fir timberland and doing soil-improvement work on the timbered lands of northern Idaho. At the Gooding State experiment station the effect of seedling alfalfa with varying quantities of seed was studied, and varieties of various farm crops were compared and improved by selection. The station officials did some extension work in connection with movable schools of agriculture, farmers' institute, and a demonstration train.

The following publications were received from this station during the year: Bulletins 68, Chemical and Mechanical Analyses of Characteristic Idaho Soils; and 69, The Farmer's Vegetable Garden.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$14,824.13
United States appropriation, Adams Act-----	13,724.29
Balance from United States appropriation, Hatch fund-----	175.87
Balance from United States appropriation, Adams fund-----	1,275.71
Farm products -----	1,956.18
Total-----	31,956.18

The Idaho station has made progress in its lines of work, undertaken the study of a number of new and important problems, and has, in general, increased its efficiency in meeting the needs of the farmers of the State.

ILLINOIS.

Agricultural Experiment Station of the University of Illinois, *Urbana*.

Department of the University of Illinois.

EUGENE DAVENPORT, M. Agr., *Director*.

The legislature of 1911 provided for special investigations by the station by the following annual appropriations: Live stock, \$25,000; farm crops, \$15,000; soils, \$65,000; orchards, \$15,000; floriculture, \$8,000; dairying, \$15,000; and soil maps and other publications, \$50,000. In other appropriations of \$19,000 for live-stock specimens, \$153,000 for buildings, and \$20,000 for the purchase of land the station is apparently interested with the college.

Work on the five Adams fund projects in progress the previous year was continued. The investigation of the effects of inbreeding of pigs was interrupted by a loss of hogs, largely due to cholera, but new material was again gathered for the continuance of the experiments.

In connection with the investigations on the digestion and utilization of feeds in maintenance, growth, and fattening the tabulation of a nutrition experiment with steers was practically completed and a report on the experiment was in preparation. An experiment designed to determine the influence of different amounts of protein upon the formation of tissue and bone was carried through the feeding and analytical stage, and work on the manuscript for a technical bulletin on this study was pursued. A feeding experiment to determine the protein requirements of lambs was carried forward and slaughter tests were made upon the 21 lambs of the experiment, together with cooking tests and tests on the strength of bone.

In the project on the principles relating to the transmission of characters work was conducted with sweet peas, strawberries, and apples. With the apple over 540 trees are on hand, grown from selected buds and being in their fourth season. In addition to this

lot there are 600 two-year-old trees grown from buds selected from five different parts of the tree, 946 one-year-old trees, and 1,240 bud-grafted on seedling stocks during this past year. The amounts of annual growth were measured and selection was practiced. Crosses were made among standard varieties.

In the study of the injury to foliage of apple trees by spraying materials attention was given to the relation of dew as a possible factor in rendering the copper soluble. The sprays used mainly during the year were Bordeaux mixture and a combination of lime and sulphur with Bordeaux mixture. The results of this work have indicated that brown spotting was caused by the presence of copper in soluble form and by free soluble arsenic, but the manner of action has not yet been worked out. Some headway was also made in the study of the yellowing of leaves, but definite results have not as yet been secured.

In statistical studies in heredity, investigations were prosecuted on the effect of the fertility of the land upon the type and variability of characters in Indian corn and upon the effect of selection for chemical composition upon the length of ear, size of kernel, and number of rows. Preliminary investigations were made in the inheritance of certain characters as well as their correlation as between parent and offspring.

Under the Hatch and miscellaneous funds the activities of the station were quite extensive. The old soil-experiment fields were continued and three new ones were established. Ten different farms consisting of 20 acres each were donated to the university for soil and crop experiment purposes, the land having been purchased by local subscription and deeded to the institution. In addition three small farms were deeded by individuals. The soil survey was carried forward and 6 counties were finished during the year, making in all 37 counties now completed. Much of this effort is in the nature of extension work, and the field men employed in it do much personal work with individuals, especially during the winter. The experiment fields are operated in connection with the soil survey. There are 31 of these experimental fields over the State, and of these about 15 are permanent, while the others are conducted on leased land. Experiments were also in progress to determine the extent of washing on southern Illinois lands.

The corn-breeding work of the station has shown that during the past six years the four strains of corn selected for high protein, high oil, low protein, and low oil are significantly different from each other with respect to length, weight, and circumference of ears and number of rows of kernels in the ear. It was found that the oil strains were a little more prominent than the protein strains. Selec-

tion was continued for height of ears and for erect or drooping position. Breeding work was also taken up from the standpoint of unit characters and their Mendelian transmission. Similar work was done with other field crops, but mainly with a view to improvement.

In animal husbandry work was continued with varying amounts of silage in fattening lambs, and experiments were made to determine the place of alfalfa and silage in the ration for beef production. The comparative cost of maintenance of horses and mules for farm work was studied, together with the value of alfalfa and clover for feeding hogs and sheep when allowed to harvest the crops themselves. During the year a long-continued investigation on market classes and grades of meat was brought to a close and the results published as Bulletin 147 of the station.

The leading work of the dairy department was the operation of the 20-acre dairy farm and the investigation into the effect of pasteurization upon the ripening of cream and the quality of butter. A number of publications on dairy topics were issued. Competitive cow-test associations have been organized and a number of herds were tested as a line of extension work. A dairy bacteriologist was appointed and the fitting up of a laboratory for the purpose of studying the milk supply of cities was begun.

The botanist continued studies on the diseases of orchard fruits and fruit trees on soil fungi and on ear rots of corn.

The following publications were received from this station during the year: Bulletins 145, Quantitative Relationships of Carbon, Phosphorus, and Nitrogen in Soils; 146, Alfalfa Hay *v.* Timothy Hay and Alfalfa Hay *v.* Bran for Dairy Cows; 147, Market Classes and Grades of Meat (with abstract number); 148, On the Measurement of Correlation with Special Reference to Some Characters of Indian Corn (with abstract number); 149, Tuberculosis of Farm Animals; Circulars 144, The Illinois Competitive Cow Test; 145, A Story of a King and Queen; 146, The Hessian Fly in Illinois, 1910; 147, Clean Milk; 148, Care of Cream on the Farm; 149, Results of Scientific Soil Treatment—Methods and Results of 10 Years' Soil Investigations in Illinois; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation, including balance from previous	
year-----	147,241.38
Farm products, including balance from previous year-----	40,649.92
Total-----	217,891.30

The Illinois station has in progress a number of lines of work which cover the State quite generally, and which have induced many

leading farmers to adopt the methods recommended and followed in these extension and demonstration activities. The results of the soil investigations throughout the State, for instance, are believed to have turned the tide of sentiment from one of soil depletion to one of soil upbuilding and improvement.

INDIANA.

Agricultural Experiment Station of Indiana, Lafayette.

Department of Purdue University.

ARTHUR GOSS, M. S., A. C., *Director.*

Changes made in the organization of the Indiana station during the year included a separation of the departments of horticulture and entomology, the former being placed in charge of C. G. Woodbury and the latter in charge of J. Troop. The chemical department of the station was abolished and the chemical work on soils and crops was placed under the department of agronomy. The station has a continuing State appropriation apportioned as follows: General purposes, \$10,000; soil and crop work, \$15,000; horticulture, \$10,000; station extension, \$10,000; dairy work, \$10,000; animal diseases, \$5,000; poultry, \$5,000; and live stock feeding, \$10,000. In addition to the station-extension fund a continuing appropriation of \$30,000 was made the past year. A new horticultural building with greenhouses was in process of construction, the greenhouses being practically completed. The station mailing list now contains about 37,000 names.

The Adams fund work of the Indiana station continued to center on four projects. The investigation of rusts progressed in a thorough and systematic way, and the work on cedar apple rust was practically completed up to publication. The growing of rusts under control in the greenhouse in order to study their full life history yielded some important results, especially regarding forms on meadow grasses, but weather conditions interfered with the work to some extent.

Hog-cholera studies, including laboratory investigations, were continued and considerable work was done in testing the normal salt solution. The production of hyperimmune hogs with a virulent normal salt solution proved less successful than it did when the work was first begun. The intraperitoneal, intramuscular, and intravenous methods of inoculation were compared, with the result that the intraperitoneal method of producing a hyperimmune hog was discarded because of unsatisfactory results. The study of cholera blood and virulent blood filtrates was continued, and a line of inoculation work for the purpose of determining the comparative virulence of blood, urine, virulent normal salt solution, filtered and unfiltered, from a cholera hog was begun.

In the project on the moisture content of butter the experiments have extended over a period of four years and were practically concluded during the past season. The controllable and uncontrollable factors in butter making were studied in connection with feeding experiments. It was found that an excess of soft fats and large fat globules take up a comparatively large amount of moisture in churning, and this is believed to be beyond control; while temperature in churning, pasteurization, and working and washing the butter are factors which may be regulated by the butter maker.

The project on the pasteurization of gathered cream in relation to bacterial flora and keeping quality of butter progressed as originally outlined. The plan is to investigate what pasteurizing temperature will produce the best quality of butter at the different seasons of the year, and the work involves the making of butter from raw cream and cream pasteurized at various temperatures, the bacteriological study of the cream and of the butter made therefrom when fresh and after several months of storage, a chemical study of the butter when fresh and after being stored, and the judging and scoring of the product. In connection with this work studies were made of analytical methods used in butter analysis for the purpose of determining their accuracy.

Many lines of station work were carried out with Hatch and other funds. The crop work under agronomy embraced various variety, cultural, and breeding experiments. Breeding and selection was practiced with wheat, corn, barley, oats, and soy beans. With corn, also, experiments in suckering and detasseling were carried on, but the results did not show that these practices were profitable. Ten corn-breeding plats in different sections of the State were conducted for the purpose of securing varieties suited to different localities. The wheat-breeding work has reached a stage where some of the strains are being multiplied. The experiments with oats included a test of 55 crosses secured from this department. The rotation and fertilizer experiments in progress for many years were continued, and work on three test fields devoted to soil improvement on more or less depleted soils in different parts of the State was carried on. Cooperative work was conducted on fertilizers for particular crops or soils, and pot and field experiments were in progress with fertilizers for potatoes on three different soil types. Other lines of endeavor included liming experiments, cooperative pasture experiments to determine the most satisfactory mixtures of grasses for pastures, and work with farmers in establishing alfalfa fields.

The horticulturist conducted orchard-management experiments in an apple orchard set out by him for that purpose on land leased for 15 years. One of the objects of this work is to test clean culture with cover crops as compared with sod, cutting the grass, and leaving it on the ground. The influence of these methods of orchard man-

agement on the rate of growth and earliness of bearing on the yield, color, and keeping quality of the fruit and on the humus content, moisture content, and temperature of the soil was also studied. In connection with extension work a large amount of data relative to the economics of apple growing was collected. Detailed cost records were kept covering all operations, and the effect of disease and insect-pest control on the net income was observed. The investigation of problems affecting the growing of tomatoes as a field crop was continued along the lines started a year ago, and a study was made of the best systems of companion and succession cropping and of the cost of and return from vegetables grown under as nearly as possible average farm-home conditions. A careful test was made of about 140 varieties of strawberries, together with tests of varieties of potatoes, small fruits, peaches, pears, plums, and cherries.

The dairy department of the station, aside from its Adams fund work, inspected creameries and dairies, conducted official tests of pure-blood dairy cows, tested Babcock glassware for accuracy, and in cooperation with this department directed its efforts toward the organization of cooperative cow-test associations for the purpose of herd improvement.

The botanical department made the usual record of the prevalence of the more important fungus diseases attacking agricultural and horticultural crops during the past year. Attention was also given to soil sanitation or the prevention of unsanitary conditions for a particular crop by the undue accumulation of fungus germs which attack and weaken the growing plants and thus reduce the yield. The study of native and introduced weeds of the State was continued and a carefully planned series of experiments on weed control was begun. Several experiments in mushroom growing were carried out.

The veterinarian operated a serum laboratory with State appropriation. The serum building was completed during the year and the preparation of the serum was transferred to it. The quantity of antihog-cholera serum produced during the past year was 1,262,296 cubic centimeters, or enough to vaccinate and treat 31,557 hogs. In the herds from which complete reports were received there was an average loss of 2.25 per cent in the vaccinated herds and 9.5 per cent in the treated herds.

In animal husbandry an investigation on lamb feeding was begun, and the experimental work in cattle and hog feeding was continued. The feeding trials with beef cattle conducted last year were practically repeated to corroborate previous results. The swine-feeding work consisted of trials to determine the value of hominy feed for fattening hogs and the comparative value of tankage and shorts as supplements to corn or hominy feed. It was found that hominy feed produced more rapid gains but at a greater cost than corn, and that

tankage produced more rapid and also more economical gains than shorts when either are fed with corn or hominy feeds. A mixture of shorts and tankage as a supplement to corn gave better results than either supplement fed separately. The first systematic attempt of the station to obtain data on the relative value of different feeds for fattening sheep was begun during the year. In September, 1910, a poultry department was started, and an experiment was begun to study the effect of protein in the form of skim milk in rations for laying hens.

The department of agricultural extension held farmers' short courses at several points in the State, operated two educational trains, established a seed laboratory in cooperation with this department, made exhibits at the State and county fairs, and carried on demonstrations in domestic science and horticulture. Assistance was given to rural school agriculture by supplying school-teachers with bulletins and weed-seed collections, and giving practical demonstrations of methods of teaching agriculture.

The publications received from this station during the year were as follows: Bulletins 141, Concentrated Commercial Feeding Stuffs; 142, Steer Feeding, V—Finishing Steers, 1907-1909; 143, Standards for Evaporated Milk, Sweetened Condensed Milk, and Condensed Skim Milk—Federal and State Dairy Laws (with popular edition); 144, Growing Tomatoes for the Canning Factory; 145, Testing Cream for Butter Fat (with popular edition); 146, Steer Feeding, VI—Influence of Age on the Economy and Profit from Feeding Calves, Yearlings, and 2-year-olds, 1906-1909; 147, Corn Silage for Winter Feeding of Ewes and Young Lambs; 148, Commercial Fertilizers; 149, Summary of Five Years' Results of Cooperative Tests of Varieties of Corn, Wheat, Oats, Soy Beans, and Cowpeas, 1906-1910; Circulars 23, Agricultural Extension, VII—How to Grow More and Better Wheat; 24, Agricultural Extension, VIII—Information on Work of Purdue Experiment Station and School of Agriculture; 25, Agricultural Extension, IX—How to Grow More and Better Corn; 26, Agricultural Extension, X—Milk Production, IV—Computing Rations for Dairy Cows; 27, Suggestions for Beginners in Alfalfa Culture; and the Annual Report, 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation, including balance from previous year	103,093.12
Miscellaneous, including balance from previous year	65,801.57
Total	198,894.69

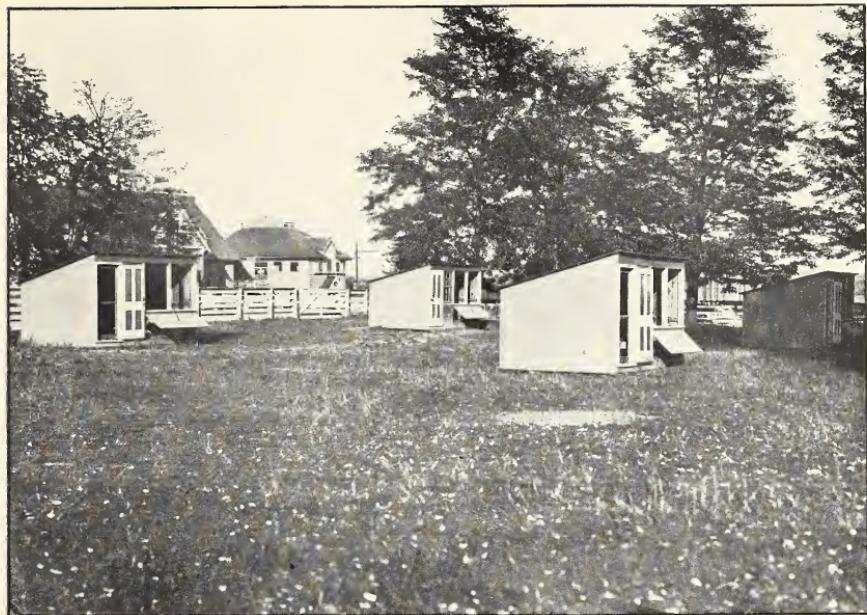


FIG. 1.—MOVABLE POULTRY HOUSES, IOWA STATION.



FIG. 2.—ORCHARD HEATING TO PREVENT INJURY FROM SPRING FROSTS, IOWA STATION.

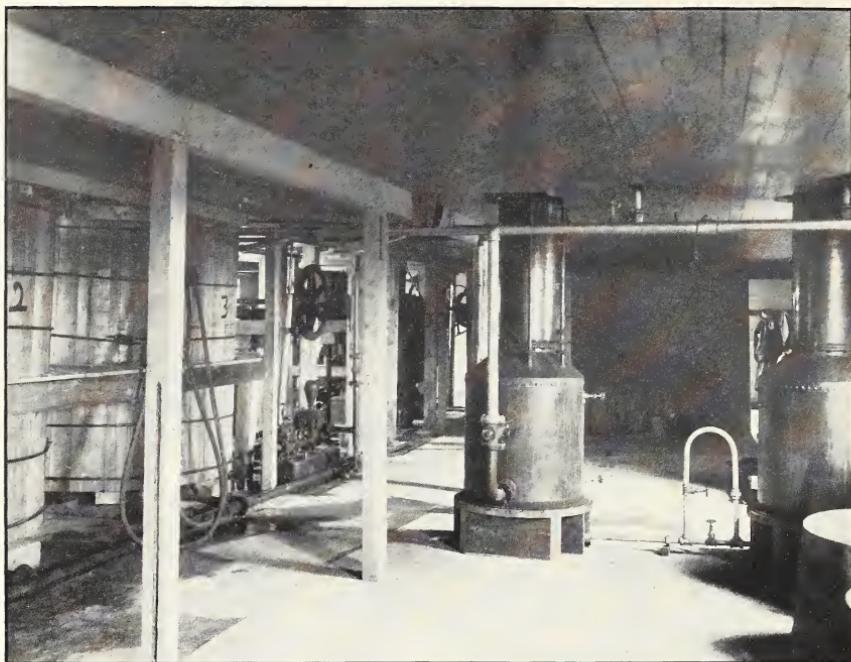


FIG. 1.—INDUSTRIAL ALCOHOL PLANT, MINNESOTA STATION.



FIG. 2.—FLOUR-TESTING LABORATORY, MINNESOTA STATION.

The affairs of the Indiana station are conducted in a systematic and businesslike way and the amount of work done appears commensurate with the funds available. The station is studying a large number of live agricultural problems of the State and is filling a position of great usefulness.

IOWA.

Iowa Agricultural Experiment Station, Ames.

Department of Iowa State College of Agriculture and Mechanic Arts.

C. F. CURTISS, M. S. A., D. Sc., *Director.*

Several changes occurred in the staff of the Iowa station during the year. C. A. Scott, the forester, was succeeded in September by G. B. MacDonald. The new chemist, A. W. Dox, entered upon his work in October, and W. A. Lippincott succeeded H. C. Pierce as poultryman. A. Leitch, in charge of the dairy farm section, resigned to take up commercial work, and was succeeded by H. H. Kildree, assistant animal husbandman of the station. P. E. Brown, of the New Jersey station, entered upon the position of soil bacteriologist in August, 1910. R. E. Neidig was appointed research assistant in the chemical department beginning with November, 1910, and at the close of the year W. F. Beckman succeeded C. V. Gregory as bulletin editor of the station.

Many useful additions and other improvements were made in the poultry (Pl. I, fig. 1) and other animal husbandry equipment, as well as in the experiment field and laboratory facilities of the station. The State has provided the station with a permanent annual appropriation of \$15,000 and an additional \$15,000 a year was given by the last legislature.

The five distinct lines of Adams fund work previously reported were continued and satisfactory progress was made. Studies on the relation of organic matter in the soil to crop production under different systems of soil management were carried on with different substances as the sources of the organic matter.

The work on humus and its relation to the physiological activities of the apple, in which the departments of horticulture and of soils cooperate, was conducted in a rented orchard with 10 varieties of apples under different methods of culture and orchard management.

The study of Mendelian unit characters in cattle breeding has resulted in 10 different matings of the blue-gray Shorthorns made by crossing the white Shorthorn bull and the Galloway cow. Observations were made on the transmission of certain characters and full written and photographic records were made.

In the study of the influence of feed, environment, and breeding on dairy cows, special attention was given to the effect of environ-

ment and of breeding to good pure-bred sires. The project started originally with 12 Arkansas cows and marked improvement has been shown by individuals from one period of lactation to another. Figures were secured on the digestive capacity of these cows and their calves up to maturity. Measurements were made of the calves to obtain data relative to their growth.

The apple-breeding project was conducted with a view to finding out the varieties containing the elements of hardiness as unit characters. Observations were made on nursery trees, including seedlings, and records were kept on a number of characters such as vigor of growth, resistance to winterkilling, and other qualities with reference to their dominance and recessiveness.

The Iowa station carries on numerous lines of work under Hatch and other funds. Soil work was conducted about the State, and a report on a study of the gumbo soils of Iowa was made in Bulletin 119 of the station. The distribution of these soils is pointed out, and their physical character is described. It was found that drainage, fall plowing, and the use of clover or other green manuring crop improved the gumbo soils, while the use of lime, even in large amounts, did not seem to better their physical condition. The application of ground limestone in its relation to certain groups of soil bacteria was studied by the soil bacteriologist.

The work of the horticultural department consisted of cultural experiments with potatoes, a comparison of northern and southern grown potatoes for seed, spraying vineyards and orchards, cold storage of apples, top-working orchards, using stocks of superior hardiness, and a study of the affinity between stock and scion. The use of heaters to protect against frosts (Pl. I, fig. 2) was tested and, with State funds, an orchard survey of the leading apple-growing county of the State was made.

The forester had in progress some forest nursery work with special reference to the farm, gave particular attention to the value of cottonwood and white pine for lumber, and tested preservative treatments of fence posts and other timbers. Plantations of the hardy catalpa in different parts of the State were studied as to their fence-post production and their financial returns.

The animal husbandry department made observations on the preparation of corn for feeding pigs, the use of forage crops for growing pigs, hogging down corn, and on feeding brood sows. Silage feeding was practiced with beef cattle to determine how much silage can be fed to advantage. Some work was also done on the effect of silage fed to sheep on birth weight and other factors. Improvement of range sheep by selection and breeding was continued as in previous years.

The poultry work included observations on the influence of pure-bred cocks on mongrel stock and on the effect of different rations in fattening poultry. Trap-nest selections were made and attention was given to the improvement of poultry-house appliances.

The dairy department gave considerable attention to ice-cream work and published during the year Bulletin 118 of the station, on a frozen product made from sour milk and called lacto. This department also gave attention to creamery construction and made observations on the shrinkage of butter in transit and in storage.

The station chemist in cooperation with the animal husbandry department made digestion studies with hogs in connection with feeding corn in different ways, and also studied the composition of the pigs at the time of birth to determine a possible correlation with the feed of the sows and other factors. In cooperation with the horticultural department he studied sugar content, acidity, and other factors in apples as characters in relation to Mendel's law.

In rural engineering the station continued its work on the construction of silos, and especially those built of tile. This line of work included the construction of masonry water tanks on the top of the silos and various waterproofing materials were tested. Work was also done on the gasoline engine for the improvement of its efficiency. The cooperative work with this office in irrigating with sewage was successful and was favored by the dry season.

A great variety of work in progress in agronomy included the breeding of grains, testing, and acclimatizing different strains and varieties, comparing various methods of making germination tests, conducting 30 cooperative tests with alfalfa in different parts of the State, breeding clover and timothy, determining the value of sweet clover under Iowa conditions, experimenting in the reseeding of pastures with different grasses, and having under trial a large number of forage crops. Corn was bred for different sections of the State in four breeding centers, and in this connection correlation studies on the relation between stock characteristics and yield were made.

The botanist carried on work in cooperation with this department on cross-pollination and self-pollination of alfalfa with and without bees, on the cytology of fertilization, and the use of pollen from the same and different plants. Studies were also made of onion smut, rust of alfalfa and timothy, and other diseases, and on the delayed germination of weed seeds.

The entomological department made a study of the wheat-head army worm as a timothy pest and published results in Bulletin 122 of the station. This department also studied the pear slug and the oyster-shell scale and tested methods of spraying in combating the codling moth and the strawberry slug.

The State has appropriated \$50,000 per year for extension work and a staff of 16 instructors is devoting its entire time to this class of work, while 10 others devote to it from three to five months each during the winter season. The extension work is so organized that the extension men are connected with the departments responsible for the information disseminated, while the head of the extension department directs these men as to when and where they shall go.

The publications received from this station during the year were as follows: Bulletins 115, Results of Seed Investigations for 1908-9; 116, Two Barley Blights with Comparison of Species of *Helminthosporium* upon Cereals; 117, The Iowa Silo; 118, Lacto: A New and Healthful Frozen Dairy Product; 119, The Gumbo Soils of Iowa; 120, The Hardy Catalpa in Iowa; 121, Creamery Bookkeeping; 122 (with popular edition), The Wheat-head Army Worm as a Timothy Pest; 123, Classification of Ice Cream and Related Frozen Products; and 124, A Centrifugal Method for the Determination of Humus.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams' Act-----	15,000.00
State appropriation -----	43,008.24
Farm products-----	10,878.64
Miscellaneous-----	864.07
Balance from previous year-----	6,255.66
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Total -----	91,006.61

The Iowa Experiment Station and the agricultural people of the State are drawing closer together every year. The station has a large amount of work of interest to the agriculture of the State and has made progress in the differentiation and organization of its extension enterprises. The generous appropriations from the State enable it to cover a wide range.

KANSAS.

Kansas Agricultural Experiment Station, Manhattan.

Department of Kansas State Agricultural College.

E. H. WEBSTER, B. Agr., M. S., *Director.*

The work of the Kansas station was materially strengthened and extended during the past year. In addition to an annual appropriation of \$22,500 for the use of the station the State appropriated \$7,500 for cooperative experiments, \$2,000 for irrigation experiments, and \$5,000 for a soil survey. The last legislature also appropriated \$125,000 for the first wing of an agricultural building, to cost eventually about \$450,000. This wing is now in the process of construction. A number of changes occurred in the staff during the year.

The Adams fund work of the station is represented by eight projects. Much time was devoted to the wheat and alfalfa breeding investigations. Three years' work on variations and correlations in wheat have been concluded, and studies were in progress on the third and fourth generations of wheat and emmer hybrids, this breeding being largely for rust resistance. In the alfalfa-breeding work drought resistance was sought, and a number of pure strains was grown. Several hybrids between common alfalfa and other forms of *Medicago* were under observation. In cooperation with the chemical department the botanist studied the physiological relations of yellowberry in wheat.

The veterinary department continued its investigations on cerebritis in horses and confined its efforts largely to a study of moldy corn in its relation to this disease. The effect of feeding moldy corn was studied, and experiments with cultures of the fungi were made. In connection with this investigation studies were conducted on the blood, brain, and tissues of the animals under observation, and arrangements were made with the veterinarians of the State to send in for examination all brains of horses dying of the disease.

The study of the factors influencing the keeping quality of eggs received much attention. Special apparatus was constructed and daily bacteriological examinations of eggs were made. The investigation included studies of eggs while in the process of formation, when newly laid, and at different stages of incubation and storage. The earliest period at which putrefactive infection of the egg may occur was sought, and the influence of the health of the hen on the keeping quality of her eggs was investigated. The influence of the bacterial content of eggs on their hatching quality was also studied, and an improved method for the bacterial examination of eggs was worked out.

In entomology the study of climate and environment on certain injurious insects was carried on in incubators in order to reduce the variable factors as much as possible. Work was pursued on the temperature and moisture factors to determine the optimum of these relations and their effect on the common parasites of the insects. The determination of the fatal temperature of the pests and its effect on their parasites, together with a study of the causes of their periodical appearance, formed a part of the work. In connection with the investigations on stored grain and mill insects, a new method of combating these insects was devised.

The study of the influence of nutrition on the form and growth of animals was carried on during the year with three lots of steers, each on a different feeding basis. The development of the skeleton as affected by the method of feeding was studied at the close of definite

periods when animals were slaughtered for the purpose. Considerable analytical work was done on the study of the digestibility of Kansas feeding stuffs.

The work conducted with Hatch and State funds was very extensive. A new farm of 320 acres turned over to the department of agronomy, and 10 acres of the old farm now used for plant-breeding work were given up entirely to work with field crops. This consisted of rotation, cultivation, and fertilizer experiments on all leading crops. Special work was in progress with broom corn, selection with forage plants, sorghum selection and testing, and Kafir corn breeding for forage and for seed. The drought of 1911 seriously interfered with all crop experiments. The soil investigations in progress included studies on the influence of the seed bed on nitrates, moisture, bacteria, and other factors. Cooperative experiments financed by special State appropriation were participated in by over 300 cooperators working with corn, wheat, oats, and other farm crops.

The animal husbandry department carried on some feeding experiments with pigs, in which corn and various supplements were fed to determine the effect of feeds on the carcass. A study was further made of alfalfa feeding of sheep in relation to lambing. A comprehensive experiment in horse feeding was conducted at Fort Riley, in which 1,000 horses were fed to test corn and alfalfa as compared with the Army ration of oats and timothy or prairie hay. The results were very favorable to the use of corn and alfalfa for cavalry horses. Some experiments were in progress on calf feeding; silage crops and sweet clover were tested with the herd. The dairy herd was considerably enlarged and the barn and yards rearranged.

Data were collected on the cost of spraying, efficiency of spraying apparatus, and the comparative value of lime-sulphur and Bordeaux mixtures. A trial of orchard heaters for protection against frost was made, and studies on the influence of pruning on fruit and bud formation, grape pruning, home-grown versus Minnesota potatoes for planting, causes of unproductiveness of tomatoes, and the effect of a Fusarium in seed potatoes. Tree planting was conducted in western Kansas to test species for windbreaks and other purposes, and a test was made of curing posts of Osage orange and honey locust.

The veterinarian conducted investigations on hog-cholera serum, blackleg vaccine, bacterins, and on the possibility of the use of muscle extract for inoculation purposes. The hog-cholera serum prepared is sold and the returns about support the work. During an extensive outbreak of hog cholera during the summer over 1,000,000 cubic centimeters of serum were sent out in one month.

The corn-ear worm was studied with special reference to its life history and field experiments made for its control. Observations were also made on methods of controlling the chinch bug and differ-

ent fruit-insect pests by spraying. Some work was begun in breeding grasshoppers to determine the laws and principles of heredity as applied to them.

The milling investigations embraced studies of the changes taking place in wheat from the time of ripening in the field until it has gone through the sweat. Milling and baking tests were made of the wheat, and the factors influencing the milling quality of flour were considered.

The publications received from this station during the year were as follows: Bulletins 168, The Common Mole; 169, Fertilizers and Their Use; 170, Breeding for Type of Kernel in Wheat; 171, Studies on Hog Cholera and Preventive Treatment; 172, The Pocket Gopher; 173, Meningo-encephalitis; 174, Spraying the Apple Orchard; Circulars 9, Rabies—Hydrophobia; 10, Provisions of the State Forest Law; 11, The Relation of Size, Weight, and Density of Kernel to Germination of Wheat; 12, Treatment of Seed Wheat for Smut; 13, How to Grow Black Walnuts; 14, Contagious Abortion; 15, Spraying Apples; 16, Burning Chinch Bugs; and 17, Protecting Trees from Rabbits; and Feeding Stuffs Bulletins 10–16, Registered Feeding Stuffs.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriations, including those for substations--	15,000.00
Fees -----	7,732.69
Farm products-----	1,323.59
Miscellaneous -----	13,683.77
Balance from previous year-----	1,593.98
Total -----	69,334.03

As a result of support from the State the work of the Kansas station has been materially strengthened and a greater amount than formerly has been made possible. Many of the new lines of endeavor have been important in carrying the work of the station to the farmer.

KENTUCKY.

Kentucky Agricultural Experiment Station, Lexington.

Department of the State University.

M. A. SCOVELL, M. S., Ph. D., *Director.*

The staff of the Kentucky station was strengthened during the year by the addition of several men who devote their time almost entirely to research work. F. M. Surface was appointed biologist in animal husbandry, R. Graham, veterinarian and in charge of serum production, and L. S. Corbett, H. H. Jewett, and H. R. Niswonger, assistants in animal husbandry, research entomology, and nursery inspection,

respectively. Since the close of the year J. H. Kastle was appointed biological chemist. With a State appropriation received last year for a hog-cholera serum laboratory, a bleeding house, a crematory, and a number of small hog cots were provided.

Under the Adams fund the investigations relative to infectious abortion in cows were continued and some promising and leading data were secured. The organism studied was tested on various kinds of animals and valuable information was obtained. The etiology of the disease was also studied in aborting mares and jennets, and observations on the physiological characteristics of two germs isolated in this connection were made. Preliminary work was done on the cause and treatment of white scours in calves, particular attention being given to determining the effect of feed on the disease. Work on milk fever was prosecuted quite actively. The urine of cows was studied to establish a normal for urine, analyses being made in about 100 cases, and to disclose the effect of the disease on this body waste.

The investigation of the nodule organisms of leguminous plants included some 34 experiments in transferring the organisms from one plant to another. The work has thus far been done on alfalfa, vetch, clover, field pea, cowpea, garden peas, soy bean, and a field bean. The organisms from certain plants were found to be identical and transferable, while in other cases they were found to be identical morphologically and physiologically, but were not transferable. The organisms of alfalfa and sweet clover were shown to be identical and that they could not be transferred to red clover.

Work was continued on the corn-ear-worm project with special reference to parasites and predaceous enemies. The study of a bacterial disease of tobacco was not actively prosecuted during the latter part of the year on account of the nonappearance of the disease. Soil studies by the chemist were continued in pot cultures, the work centering on soils responding to applications of potash.

The work of the station conducted with Hatch funds included feeding experiments by the department of animal husbandry, with forage crops pastured off by hogs, and a comparison of various grains and other feeding stuffs in dry-lot feeding.

The department of entomology had charge of nursery inspection under a State fund, conducted some experiments in spraying tobacco with different insecticides, and worked on the life history of the large slug. This department also carried on some lines of work in agronomy.

The chemical department made analyses of limestones and phosphate rock to determine their value for agricultural use, and studied methods for the analysis of phosphate rock and certain insecticides and for the determination of potash in soils and fertilizers. Deter-

minations of carbon dioxid in soils were made and field experiments were conducted on the depletion of potash in the soil of the station farm as due to tobacco growing. Numerous soil analyses were made for farmers and others, and the analyses of phosphate rock have been a factor in placing the mining of this rock in the State upon a commercial basis.

The work in agronomy covered experiments with corn on the rate of planting, methods of cultivation, selection of long as compared with short, and rough with smooth ears, and ear-to-row tests in the improvement of varieties. Culture and variety tests were continued with the soy bean and attention was given to methods of handling the crop for hay. Other activities along agronomical lines included variety tests with wheat and oats, work with spring and winter barley, inoculation experiments with alfalfa, and fertility and rotation trials.

The cooperative work of the station with this department consisted of rotation experiments now under way for several years, the inspection of imported florists' stock brought into the State, sheep-dipping experiments, and work with barley, oats, and tobacco. The station also cooperated with the State geological survey in soil work.

The extension work of the station other than cooperative experiments was done mostly in connection with the public schools, normal schools, and with farmers' institutes. In this connection a number of the station staff gave lectures during the year.

The publications received from this station during the year were as follows: Bulletins 146, Commercial Fertilizers; 148, Seed-testing Apparatus—A Study of Conditions under which our Germination Tests are Made; 149, Bleached Flour; 150, The Preservation of Drugs; 151, An Outbreak of Gadflies in Kentucky; 153, Boys' Corn Clubs and Improved Methods of Corn Growing; and the Report on Food and Drugs for 1908-9.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation, including balance from previous year-----	31,773.52
Fees, including balance from previous year-----	64,385.66
Farm products, including balance from previous year-----	13,170.58
Miscellaneous, including balance from previous year-----	1,500.43
Total-----	140,830.19

The Kentucky station has developed into a large enterprise with many interests. Its inspection work has been organized on an efficient basis, and the addition to the administrative staff of a number of experts the past year should materially strengthen its experimental and research features.

LOUISIANA.

- No. 1. Sugar Experiment Station, *Audubon Park, New Orleans.*
- No. 2. State Experiment Station, *Baton Rouge.*
- No. 3. North Louisiana Experiment Station, *Calhoun.*
- No. 4. Rice Experiment Station, *Crowley.*

Department of Louisiana State University and Agricultural and Mechanical College.

W. R. DODSON, A. B., B. S., *Director, Baton Rouge.*

The changes on the staff at the Louisiana stations during the year included the appointments of H. Morris to succeed T. C. Paulsen as animal pathologist, and of S. G. Chiquelin as assistant director of the sugar station to succeed H. P. Agee, who resigned to become assistant director of the Hawaiian Sugar Planters' Station. R. G. Tillery, assistant chemist, left the station to go into commercial work, and W. E. Cross was elected to the position of research chemist in charge of Adams fund work. G. Tiebout was given charge of a truck farm for the college of agriculture, affording facilities for some experimental work. In this connection an irrigation plant with a 12-horse-power gasoline engine and a pumping capacity of 300 to 400 gallons per minute has been installed.

At the station at Baton Rouge the facilities for work in the department of plant pathology were enlarged and considerable new equipment was acquired. The dairy was also enlarged and a concrete silo 10 feet in diameter and 40 feet high was constructed. The State appropriations for the year ended June 30, 1911, were \$17,000 for the sugar, State, and North Louisiana stations and \$7,500 for the rice station at Crowley.

Although some interruption was caused by changes on the staff, the work of the stations made good progress during the year. Under the Adams fund, work on the cottonseed-meal project was continued with pigs, guinea pigs, and rabbits fed with differently treated meal and seed to determine the effect of the different treatments on the toxicity of the products. Salts of phosphoric acid were also used in the feeding experiments, and studies were made of the possible connection of fungi such as the boll rots with the degree of toxicity. The work on the anthrax project was largely confined to studying the rôle of certain birds and insects in the spread of the disease. Cerebro-spinal meningitis was studied by testing the effects of feeding the common molds to horses, rabbits, and guinea pigs. Owing to lack of material, work on the "foot evil" of the horse was held in abeyance.

In plant pathology the bean-anthracnose project was continued by a further study of the means of prevention, and considerable time was devoted to the further study of cotton wilt and the cotton-boll

rots. The life history of the principal organisms connected with these cotton diseases and their relation to the host plant were worked out and some of the results are soon to be published. The investigation of the fig diseases was completed, the perfect stage of fig anthracnose having been worked out, and the results of the study were published as Bulletin 126 of the station. Considerable work was done on the sugar-cane diseases, and a bulletin on the subject was published during the year. This work included a study of the distribution of the diseases in the State and the life history of the different causative organisms. A large number of successful inoculation experiments were carried on with the organism causing the red-rot disease. In studying the wilt disease of pepper, special attention was given to the distribution of the fungus on different host plants and to the resistance of the sclerotia to different chemicals and to desiccation. Studies of the life history of an alfalfa disease were continued, and notes were also made on a leaf spot attacking this crop. A lack of material prevented work on rice smut during the past year.

The investigations on conditions most conducive to complete combustion in bagasse furnaces were reported upon. A drier has been designed by means of which the moisture content can be determined and studied. During the past cane-grinding season the drier was operated in 40 tests of eight hours each. The efficiency of the drier was found to be about 30 per cent and the fuel value of the bagasse to be increased about 32 per cent. The results of this work on moisture contained in bagasse and its influence on fuel value, the conditions influencing combustion of bagasse, and other matters connected with the problem have all been published and the work is considered as completed. The station deems it a matter of practical mechanics to adapt machinery to the accomplishment on a large scale what it has accomplished in an experimental way.

The bacteriological study of raw sugars and sugarhouse products was continued and a bulletin entitled "The Bacterial Deterioration of Sugars" was published during the year. Particular attention was given to the relative rates of deterioration of various types of sugars and the conditions that cause deterioration, including more particularly moisture, temperature, and the presence of impurities. A study was also made of the highly acidifying types of organisms in sugar and the influence of these organisms and their products on the deterioration of sugar.

In studying the nonsugars of sugar cane, work on the pentosans, carbohydrates, and nitrogen constituents in cane was taken up. During the grinding season special attention was given to the means of adapting the carbonation process to clarification of cane juices, and some important facts regarding the influence of temperature and degree of alkalinity were developed. A much greater percentage of

impurities than has heretofore been possible in sugarhouse practice was removed in experiments undertaken. Encouraging results were further secured in an effort to recover some of the large percentage of sugar left in cane-sugar molasses. A study was also made of the composition of cane fiber preliminary to an evaluation of bagasse.

A wide range of work was carried on with the Hatch and other funds. The work in agronomy embraced experiments in maintenance of soil fertility, crop rotation, effect of removing suckers from corn, sources of nitrogen for corn, cultural methods, pasture experiments, and other field and forage crop work. In animal husbandry, tests were made of sweet potatoes for pig feeding and the relative value of full-blood, one-half, and three-quarter grades of swine for pork production was studied. Additions were made to the dairy herd and the results of three years' feeding experiments with dairy cows were prepared for publication. In horticulture some experiments in shipping produce and trials of methods of storing, seed selection of tomatoes, and similar work were carried on. Work in tick eradication was carried on with other than station funds, while work with hog-cholera serums was under the direction of the State sanitary board. The chemical department did all the chemical work from the station departments in addition to making digestion experiments with lespedeza hay, molasses, and other feeding stuffs, testing the value of rock phosphates, and making a study of various root crops when tested for milk production.

The North Louisiana Experiment Station at Calhoun purchased about 80 acres of land adjacent to that already owned for the purpose of expanding its hog-feeding experiments. The past year hog-feeding experiments were conducted with corn, cowpeas, and sweet potatoes. A selected strain of Irish potatoes gave a yield of 40 bushels per acre in excess of commercial seed. The station also demonstrated that certain varieties of grapes can be commercially grown if proper attention is given to spraying. Seed of crimson clover in good quantity and quality was secured on large plats of hill lands.

The rice station at Crowley gave particular attention during the year to methods of exterminating red rice, trials of crop rotations, and fertilizer tests. During the year a barn and implement store-room costing about \$2,000 was completed. Improvements were also made about the well and pumping plant and a good equipment for irrigation was thereby secured.

The publications received from this station during the year were as follows: Bulletins 120, Some Sugar-cane Diseases; 121, A Preliminary Report on the Sugar-cane Mealy Bug; 122, Rough Rice as Feed for Horses and Mules; 123, Some Experiments in Grazing and Soiling; 124, part 1, Breeds of Hogs; part 2, The Best Crops to

Grow for Hogs, and Other Data; 125, The Bacterial Deterioration of Sugars; 126, Diseases of the Fig Tree and Fruit; Fertilizer Report, 1909-10; and Feed Stuffs Report, 1909-10.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation, including balance from previous year -----	24,857.32
Individuals -----	250.51
Fees -----	2,000.00
Farm products, including balance from previous year--	3,763.04
Miscellaneous -----	1,734.15
 Total-----	 62,605.02

The Louisiana stations are studying numerous problems connected with the various lines of agricultural industry of the State, and are broadening their scope to meet the needs of a growing agriculture, which in some of its branches is peculiar to the region.

MAINE.

Maine Agricultural Experiment Station, Orono.

Department of the University of Maine.

C. D. Woods, Sc. D., *Director.*

The principal change in the staff of the Maine station during the year was the resignation of F. M. Surface, assistant biologist, to accept a similar position in the Kentucky station. His place was filled by the appointment of E. P. Humbert, who has resigned since the close of the fiscal year to take up work in agronomy at the New Mexico station.

The work on the Adams fund projects at this station progressed steadily and constituted a large part of the station work. The study of potato scab was followed along the same general lines as heretofore. The effect of different kinds of manure on the development of the disease was studied and investigations regarding the length of time the fungus is able to live in the soil were made. Laboratory work on the blackleg of potatoes was continued, comparative studies of organisms from Canada and Germany being made, and methods of treatment given trial. Some preliminary work was done on the early blight of the potato.

In the research work with poultry the system of breeding based on the ability of the birds to transmit high-laying qualities to their offspring rather than on performance alone continued to promise good results. This year's work gave additional evidence that high-laying ability is a characteristic of a certain few blood lines in the

station's flock, and that by isolating these lines and breeding them pure it will be possible to establish a strain in which high production is a fixed characteristic. The results secured with the second and third generations were prepared for publication. A study of the factors concerned in egg production progressed well toward completion. A detailed study of the microscopical structure of the oviduct of the hen was made, and the time of the formation of the watery albumin, to some degree a normal constituent of all hen's eggs, with reference to the formation of other parts of the egg, was determined. These fundamental scientific studies carried on by the station for some years have enabled the institution to give out information of important practical bearing regarding the origin and control of various factors influencing the market quality of eggs. The experiments in reciprocal crossing of breeds of poultry were continued, with good results. The manner in which a number of the characters of the fowl are inherited has been worked out in detail and the first report of these studies was published in Bulletin 179 of the station.

The accumulated data on the interrelation of apple diseases were summarized and published during the year. An apple rot caused by a new and undescribed fungus, belonging to a class not before reported from America, was described in a technical paper.

In connection with the study of variation in fungi, as the result of environment, 3 different *Fusarium* forms were isolated from apples and about 25 other forms from other plants. These fungi were grown in different culture media for comparison, and a large portion of the data was held ready for publication.

The entomological research work made good progress, and several publications were issued. The investigation of fungus gnats was completed during the year. About 300 species have been studied and all the important economic phases of the problem were covered. The species of gnats especially affecting cultivated plants were bred for the purpose of study. In the work on plant lice a form on alder and maple trees was studied, and pea and potato aphids were compared for structural characters. Considerable preliminary work was done in studying the early stages of economic species of Diptera, Psyllidae, and the native hymenopterous and dipterous parasites destructive to injurious insects of Maine.

The field work of the station under the Hatch fund was largely carried on at Highmoor, where improvements in renovating orchards and in getting the farm into shape for various other lines of experimental work were actively pursued. A seedling orchard of over 2,000 French crab and about 1,000 Tolman Sweet root-grafted scions was set out for a long-time stock and scion experiment. Experiments with the apple carried on cooperatively by the horticultural

and biological departments of the station included the crossing of different varieties. Ear-to-row tests of corn and sweet corn were conducted, and varieties of oats were compared on 31 plats. Much attention was given during the year to the selection of promising plants from the different experimental plats with a view to obtaining improved varieties of corn and oats adapted to Maine conditions.

The inspection work of the station for which the State has made an appropriation of \$9,000 was carried on as heretofore. Recent laws have given the station greater power in the control of food, feed, insecticides, and fungicides. The State department of agriculture furnished funds to aid the State Rural Improvement Association, and work in this connection was done by the extension department.

The publications received from this station during the year were as follows: Bulletins 179, Poultry Notes; 180, The Fungus Gnats of North America, II; 181, Gall Aphids of the Elm; 182, Four Rare Aphid Genera from Maine; 183, Experiments in Breeding Sweet Corn; 184, Digestion Experiments with Poultry; 185, Maine Apple Diseases; 186, Finances, Meteorology, Index; 187, Insect Notes for 1910; 188, Field Experiments; and 189, Orchard Spraying Experiments.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation-----	5,200.00
Fees-----	12,000.00
Miscellaneous, including balance from previous year---	2,658.93
 Total-----	 49,858.93

The affairs of the Maine station are in good condition and its work is generally thoroughly done. The position of the station has been greatly strengthened by the acquisition of the Highmoor farm.

MARYLAND.

Maryland Agricultural Experiment Station, College Park.

Department of Maryland Agricultural College.

H. J. PATTERSON, B. S., *Director.*

The principal lines of work at the Maryland station were not changed materially during the past year, the financial support given by the State remained the same, and no new buildings were added to the equipment.

Considerable progress was reported on several of the station's Adams fund projects, and some of these investigations were brought

well toward completion. The laboratory study on the diffusion and depletion of lime in the soil was about completed, and the work of compiling the results for publication was taken up.

A bulletin was published setting forth some of the results obtained in the study to straighten out the classification of the hymenopterous family Braconidae and to learn more about the habits and the host relations of the different species. In this bulletin five new species were described, additional characters were pointed out, and errors in former descriptions were corrected. This work was based in part on a large series of reared specimens of various species and on results secured in breeding from known parents.

The study of the bacteria and animal organisms in the intestinal contents and mucosa of healthy chickens was completed, and a bulletin giving results was published. The purpose of this bulletin was to set forth the methods used in making the examinations, together with the results obtained wherever of value as a contribution to the physiological and pathological bacteriology and protozoology of the intestines of healthy domestic fowls. The observations were made upon the feces of 45 birds, ranging in age from 1 day old up to 2 years, and upon the intestinal mucosa of 60 birds, including birds taken from the shell, newly hatched chicks, and fowls ranging in age up to 2 years. It was found that chickens reared under sanitary conditions do not harbor many animal organisms. Heterakis worms and tapeworms found in healthy birds were believed to indicate some insanitary condition of the poultry yards. A study of white diarrhea in chickens and the possibilities of its prevention by subcutaneous and intravenous injections of some phenol compounds into fowls whose ovaries are infected was taken up during the year.

A number of other lines of work were carried on under Hatch and other funds. In agronomy, cooperative wheat, oats, and barley tests were made in different sections of the State, one to four varieties of wheat being tested by each of 30 farmers, one to three varieties of winter oats by each of 10 farmers, and a variety of winter barley was grown by several experimenters. Alfalfa was tested at two different points in the State and the station cooperated with the authorities in 10 counties in conducting corn-growing contests. Tobacco investigations were conducted in cooperation with this department. The work outlined last year was continued and four series of new rotation tests were begun, the crops entering into rotation with tobacco being crimson clover, vetch, winter oats, cowpeas, potatoes, wheat, and red clover.

The horticultural department of the station made changes in its fruit plantations by removing some of the old orchards and vineyards and making new plantings for study and experiment. An overhead sprinkling system of irrigation was installed to irrigate

a strip 40 feet by 300 feet for experiments with vegetables. A test of the use of orchard heaters for protection against late frosts was extended to include two points in western Maryland, one on the Eastern Shore, and one in the experiment-station orchard. A test was also made of these heaters for protecting strawberry beds.

The botanist identified a large number of plants sent in for that purpose and determined the purity of many samples of seed. He gave considerable time to the study of tomato variations in conjunction with the work conducted in the horticultural department. Studies of the leaf-mold fungus and the leaf-spot fungus of the tomato were also carried on. A bulletin was prepared covering all phases of the weed question and including the results of tests on the eradication of certain weeds made during the past 9 or 10 years.

The work of the department of entomology was continued along the same lines pursued the year before. The results of spraying, fumigating, and dipping for the control of San José scale were summarized and published in bulletin form. It was found that the pest can be very successfully controlled by thorough applications of the remedies recommended. A study was also made of the distribution of the terrapin scale within the State and the results of methods tested for its control were compiled and published. It was found that a standard miscible oil, employed at a strength of 1:15, applied just as late in the spring as possible before the buds open is quite effective in controlling this pest. A cooperative study of beekeeping in Maryland was carried on with this department and the results, which are largely statistical with reference to the industry in the State, were published in bulletin form.

The poultry work of the station was pursued along the same lines outlined in the last report, but in addition the value of feeding mixtures composed of grains produced on the farm was tested; rations composed of corn and wheat products were compared as to their influence on the quality and quantity of the eggs; the length of time required for eggs to become fertile after the male is placed with the hens and the length of time eggs will remain fertile after the male is removed was determined; and the effects of age of eggs on incubation were studied. The department cooperated with the college in giving a 10-day special poultry course, and also prepared several poultry exhibits.

New lines of work in animal husbandry included experiments with pigs and cooperative dairy field work. Experiments were made with different rations and with different methods in feeding pigs, and attention was given to the construction of two types of hog houses. In cooperation with this department the station has been instrumental in the forming of cow-testing associations and dairy-breeding associations. At the station the results of keeping cows in an open

barn continued to be very satisfactory. The cows in the open barn made as good yields as those in the closed barn, while the cost of food for producing 100 pounds of milk in the open barn was a little more than in the closed and the cost of labor less.

Demonstration and cooperative work was conducted on about 100 different farms of Baltimore County, and covered variety tests of corn, potatoes, small fruits and orchard fruits, fertilizer experiments, the use of burned and unburned lime, improvement of wheat by head selection, tests of methods of seeding timothy and clover, and the use of crimson clover as a cover crop. Demonstrations were also conducted during the year on about 8 acres of the station farm of the use of dynamite for clearing the land of stumps, digging ditches, and digging holes for setting trees.

The following publications were received from this station during the year: Bulletins 145, Tuberculosis of Animals; 146, Poultry House Construction and Its Influence on Domestic Fowls, I; 147, Wheat—Variety Tests and Diseases; 148, Spraying, Fumigating, and Dipping for the Control of San José Scale; 149, The Terrapin Scale; 150, Pig Feeding Experiments and Two Kinds of Hoghouses; 151, Fertilizers on Asparagus; 152, Aphidiinae of North America; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation, including balance from previous year	14,037.03
Farm products, including balance from previous year	8,264.36
Total	52,301.39

The general interest in the Maryland Experiment Station and its work showed a steady growth during the year, and the demand for help along certain lines was greater than the institution was able to give.

MASSACHUSETTS.

Massachusetts Agricultural Experiment Station, Amherst.

Department of the Massachusetts Agricultural College.

W. P. BROOKS, Ph. D., *Director.*

At the Massachusetts station the new entomological building was formally dedicated November 11, 1911. Several changes on the staff were made during the year, the principal one being the permanent appointment of F. W. Morse as research chemist. The State made an appropriation of \$7,500 for improvements in the chemical laboratory. With this amount a fireproof vault of considerable capacity has been constructed. Provision was also made for two laboratories to be

used exclusively in the research work of the chemical department. At the cranberry substation in Wareham a screen house and laboratory was erected at a total cost of \$2,500. The last legislature made an appropriation of \$75,000 for a new dairy building for the college and station.

The Adams fund work of the station made the usual progress during the year. The work on milk secretion continued to involve studies of methods for the quantitative determination of insoluble fatty acids. Methods for the purification of unsaturated fatty acids were also studied. Considerable advance was made in the establishment of reliable methods. The influence of various factors on the rancidity of fat was investigated, and the effect of molasses and other carbohydrate substances in the ration was given further study.

The departments of entomology and chemistry continued their co-operation in the study of the conditions under which arsenical compounds used as insecticides are injurious to foliage. In this connection, chemically pure acid arsenate of lead, meta-arsenate of lime, and Paris green were prepared. This work is essentially an effort to standardize spraying on the basis of pure materials. The accumulated data were partly published and partly prepared for publication during the year.

The plant-breeding work of the station included a study of the variation of apples, with special reference to the cause of different forms. A close relation between variation and temperature was found to exist. Chemical work on 100 varieties showed each variety to have its special chemical composition and its own course of development. Biometrical work with peas included the examination of 10,000 plants during the summer. The results indicated that the common varieties of garden peas are made up of subgroups or strains differing markedly in productiveness, and it was suggested that advantage be taken of this fact in the improvement of the crop. Studies of Mendelian inheritance were continued with beans, squashes, nasturtiums, and pansies, special attention being given to various characters and their correlation.

In the study of the digger wasps the entomological department investigated the group specially with reference to their value as parasites.

The investigations on asparagus were carried forward along the same general lines followed the year before. The results thus far secured did not warrant conclusions as to the relations of different plant-food elements to yield, but the results in the past season seem to indicate the value of nitrate of soda in increasing rust resistance. The effect of several elements of fertility on the chemical composition of the plants was also studied.

The principal field work on the cranberry project was conducted at East Wareham on the 12-acre bog recently secured with State funds. Considerable work was done during the year in improving the bog and preparing it for various lines of experimental work. In addition to the field work, studies were carried on in closed plats of a new and original type, assuring control of different factors in which it is believed the chemical changes occurring in cranberry bogs, and which may be induced by different fertilizer applications, can be closely followed. The relation of injurious and beneficial insects to cranberries also received attention.

Two publications were prepared on the results obtained in studying the relations of climate to the development of plants and crops in health and disease. This study included investigations on light with reference to plant growth and to greenhouse construction and to the development of tip-burn of lettuce, tomatoes, and cucumbers, and of the mosaic disease of tobacco.

A number of important lines of work were carried on under the Hatch and State funds. The agriculturist continued observations on the top-dressing of pastures and permanent mowings, and gave further attention to the subject of alfalfa culture. It was determined that profitable hay crops may be produced in permanent mowings by top-dressing with fertilizers only, and that a combination of slag meal and potash salt produces hay made up chiefly of Kentucky blue grass and white clovers. The use of slag meal and low-grade sulphate of potash as a top-dressing for pastures gave good results and favorably modified the character of the herbage. The experiments and observations with alfalfa led to the conclusion that the crop can be successfully grown in Massachusetts.

The horticulturist studied the effect of summer and winter pruning on bud formation, gave attention to the renovation of different types of apple trees, continued the experiments of varieties of different botanical species of plums and with 11 different stocks of apples to determine the effects of stock on scion, made observations with reference to season of ripening and color and quality of fruit, and conducted variety work with different groups of peaches, plums, and apples, and fertilizer work in orchards.

The botanical department followed work relating to soil biology, studied methods of soil sterilization and their effects, and continued spraying work, including the devising of more efficient nozzles. Attention was given to the abnormalities of stump growth, and an article on this topic was published in the station report for 1911. This department also conducted experiments relating to the prevention of the clogging of drain tile by roots, and found that either excelsior or sawdust first saturated with creosote and packed about the joints of drain tiles keeps the roots from entering.

The entomological department conducted a cooperative experiment on methods of controlling wireworms on seed corn. Studies on the relative importance of the different broods of codling moth have been in progress since 1903. A study on the control of onion thrips was completed and studies of the elm-leaf beetle and asparagus beetle were continued. Efficient methods for combating onion thrips were suggested and definite regional limits of the elm-leaf beetle and asparagus beetle were mapped out. The organization of apiary inspection under a new State law was begun during the year.

The chemical department of the station studied the cause of clover sickness, varieties of corn best suited for silage in Massachusetts, and the value of coconut meal in milk production. The inspection of the department was carried on as heretofore, but a separation of the inspection work from the experimental work was effected and thereby much better facility is secured for the more scientific work of the department.

The veterinarian of the station took part in studies on Sporothrix and epizootic lymphangitis and a report on this work has been published.¹

At the cranberry station the Skinner system of irrigation in its relation especially to frost protection, winter flowage, and spraying for insects and fungi, was tried and the improvement of varieties of cranberries by selection and breeding was carried on.

A more complete organization of the extension department of the college has been effected and the staff of this department was increased. As a result of this step station officers are doing much less extension work than heretofore. The cooperative work of the station consists of cooperative experiments in alfalfa culture with parties throughout the State and with this department in the work with asparagus and cranberries.

The following publications were received from this station during the year: Bulletins 133, Green Crops for Summer Soiling; 134, The Hay Crop in Massachusetts; 135, Inspection of Commercial Fertilizers; 136, Inspection of Commercial Feed Stuffs; 137, The Rational Use of Lime—The Distribution, Composition, and Cost of Lime; Meteorological Bulletins 258–269; Circulars 18, Alfalfa as a Crop in Massachusetts; 19, The White Fly; 20, The Use of Lime in Massachusetts Agriculture; 21, The Control of Onion Smut; 22, Poultry Manures, Their Treatment and Use; 23, A Parasite of the Asparagus Beetle; 24, An Act to Provide for the Protection of Dairymen—The Babcock Test; 25, Cottonseed Meal; 26, Fertilizers for Potatoes; 27, Seeding Mowings; 28, Rules Relative to Testing

¹ Jour. Med. Research, 23 (1910), No. 1.

Dairy Cows; 29, The Chemical Analysis of Soils; and the Annual Reports for 1909 and 1910, parts 1 and 2.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation, including balance from previous year	17,698.48
Individuals	25.00
Fees	6,239.83
Farm products	2,068.85
Miscellaneous	9,601.69
Total	65,633.85

The Massachusetts station is doing a large amount of useful, scientific, and practical work. Its field is constantly widening, and the more complete organization of the extension department of the college can not fail to be of great assistance to the station in relieving it of extension duties.

MICHIGAN.

Experiment Station of Michigan State Agricultural College, *East Lansing.*

Department of Michigan State Agricultural College.

R. S. SHAW, B. S. A., *Director.*

The staff of the Michigan station was enlarged during the year by the creation of several new positions. These new places were filled by the appointment of W. H. Brown as plant physiologist, G. H. Coons as plant pathologist, and George Bouyoucos as research assistant in the division of soils. Some rearrangement was also made in the veterinary department of the station, W. S. Robbins assuming the duties for which W. G. Giltner was formerly responsible. Beyond this the station force remained intact and manifested a degree of permanency. A tract of land containing 600 acres and adjoining the Upper Peninsula station at Chatham was donated to the station by the Cleveland Cliff Iron Co. It is proposed to establish on this land a model demonstration farm for the Upper Peninsula, which possesses different environmental conditions than the other portion of the State. A soil house was constructed at the main station during the past year for the purpose of serving field projects under the Adams fund, and a piggery was constructed to foster the preparation of hog-cholera serum.

Work on the several Adams fund projects in hand was continued, and some of the results were published during the year. In the study of the keeping qualities of butter the efforts were centered mainly upon pasteurization and ripening as compared with nonpasteurization and nonripening in lessening the deterioration of butter in storage.

Work was also done with yeasts and torulæ found in milk and butter, with various strains of *Bacterium lactis acidi*, and on troubles with off flavors in milk and cream. A paper was published on the fermenting capacity of the average single cell of *B. lactis acidi*.

The investigation of infectious abortion in cattle during the past year resulted in the isolation from the exudate and cotyledons of an aborting cow the bacterium described by Bang and others as occurring in epizootic abortion, and work was taken up with a view to establishing a lactic flora on the genital mucosa for the purpose of overcoming and of preventing the reappearance of the abortion and other objectionable bacteria. The problem was approached by studying the normal and abnormal flora of the genital passages and of the flora after treatment with lactic cultures.

The chemist continued the study of the organic nitrogenous compounds in soils and their variability, together with the study of the chemical factors rendering soluble the insoluble phosphates of the soil. The laboratory investigations in connection with these studies were supplemented by pot experiments. Papers were published during the year on the neutral ammonium citrate solutions and the use of Busch's nitron for the determination of nitrate nitrogen in soils and fertilizers.

The botanist entered upon a study of the twig and branch cankers of apple and peach, and the entomologist continued to give attention to the agents instrumental in destroying insects. A bulletin on part of the entomological problem and entitled "How do contact insecticides kill insects?" was published.

Among different lines of work conducted with Hatch and other funds the veterinarian studied several diseases which broke out in the State during the year. These included infectious anemia in horses, malignant catarrh and granular vaginitis of cattle, avian tuberculosis, worms in pigs, and an unknown disease in cattle and one in sheep. The agglutination work conducted for two or three years past in connection with the Dorset-Niles serum production was completed, and the results were published as Technical Bulletin 8. This department also tested 510 cattle for tuberculosis, of which 8 were condemned.

In soil bacteriology, a study was made of the rôle of microorganisms in the building up of the barren sand of the Jack pine plains and of peat. Particular attention was given to the formation of humus, the decomposition and availability of peat compounds, and the peculiarities of peat as a soil. Other problems in hand concerned largely the technique and reliability of methods in common practice. The department of bacteriology also prepared and distributed cultures for the inoculation of leguminous crops, alcohol-acetic cultures and lactic cultures, and hog-cholera serum.

The chemist entered upon a study of the manufacture and storage of lime-sulphur-spray solution, and worked in cooperation with the horticulturist on the influence of cover crops and commercial fertilizers in grape culture. In addition to this work, attention was given to the analysis of 120 samples of a miscellaneous nature sent in by residents of the State and to the fertilizer control work.

The horticultural work included the continuation of cover crop and fertilizer tests in vineyards and orchards. The cover crops under trial were buckwheat, velvet bean, spring vetch, cowpeas, winter vetch, oats, and rye. Winter vetch, sown at the rate of 25 to 30 pounds of seed per acre in July or August, proved the most promising cover crop planted. Tests were also continued to determine the advantages of spraying potatoes to protect them from blight and rot, and spraying tests of orchard fruits were continued for the comparison of self-boiled lime-sulphur mixture, dilute boiled lime sulphur, and Bordeaux mixture on apple, cherry, plum, and peach. A report was made during the year on a series of potato fertilizer experiments.

The time of the botanical department was taken up largely with matters of reorganization and equipment and with the examination of seed samples as provided by the pure-seed law of the State, together with the study of weeds. Attention was further given to combating the rot knot of ginseng and to the determination of plant diseases.

The entomological work of the season included studies of cutworms, plant lice in orchards, Tussock moth, rose chafer, and wire-worms. Special efforts were continued in establishing effective measures for the control of the tamarack sawfly, and in this connection a parasite was introduced and this insect was liberated in the Upper Peninsula for the purpose of overcoming the tamarack pest in that section.

The farm crop work of the station consisted mainly of the breeding of wheat, oats, rye, barley, beans, soy beans, cowpeas, clover, alfalfa, timothy, and orchard grass, together with a study of the effect of manures and fertilizers and the rotation of crops on soil fertility. A number of select clovers were set out in the nursery and a small variety series of alfalfa was started during the year. An experiment, known as the Davenport fertility and rotation experiment, was discontinued and the data were summarized during the year.

The South Haven substation gave attention mainly to spraying tests for combating plant diseases and insects pests attacking bush and orchard fruits and the study of varieties of apples including some new or little-known sorts.

The extension work of the station was devoted mainly to the introduction of alfalfa, testing varieties of corn, and the distribution of seed of promising varieties of field crops. In this work the station is aided materially by the Michigan Experiment Association. The station also gave some assistance at corn shows, fairs, farmers' institutes, and other popular means of disseminating agricultural knowledge.

The publications received from this station during the year were as follows: Bulletins 260, Seeds of Michigan Weeds; 261, Baby Beef Production; 262, Suggestions on Planting Orchards; 263, Fertilizer Analyses; Special Bulletins 51, Spray and Practice Outline for Fruit Growers; 52, Corn Production in the Upper Peninsula of Michigan; 53, Grasshoppers and Their Control; 54, Spray and Practice Outline for Fruit Growers, 1911; Technical Bulletins 5, The Usefulness of Curves in the Interpretation of Microbial and Biochemical Processes; 6, Lime-sulphur Spray; Circulars 7, Lactic Cultures for Dairy Purposes; 8, Tuberculosis; 9, Vinegar and Its Making; 10, Manufacture and Storage of Lime-sulphur Spray; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation	6,187.87
Fees	4,540.00
Miscellaneous	246.23
Balance from previous year	2,324.52
 Total	 43,298.62

The field of activity of the Michigan station continues to grow, and with its organization on a broader basis and the resulting differentiation of lines of work, to some extent related, the efficiency of the institution in experimental and research work is increasing.

MINNESOTA.

Agricultural Experiment Station of the University of Minnesota, *University Farm, St. Paul.*

Department of the University of Minnesota.

A. F. WOODS, M. A., *Director.*

The different lines of work pursued at the Minnesota station made satisfactory progress during the year and no important changes occurred in the station staff. No new buildings were constructed, but the installation of the experimental industrial alcohol plant was completed. This plant has a capacity of 100 proof gallons of alcohol per day and is equipped with continuous stills, pressure grain cooker, and other necessary apparatus. (Pl. II, fig. 1.)

Progress was reported on all Adams fund projects. Further results secured in the stable ventilation project were summarized for publication in bulletin form, and in the project on food requirements for milk production a large amount of data was tabulated and some of the results were worked up for technical and popular bulletins. In the study of the relation of type of animal to beef production work was taken up with the fifth lot of steers.

The influence of the method of cropping on soil fertility was studied on about 50 plats. The work has largely been a study of the humus in the soil when the permanent plats were laid down, as compared with the humus content 10 years later and at similar intervals. Marked differences were noted in the amount and composition of the humus present and some striking differences were noted in the effect on different crops. The potash, phosphoric acid, and nitrogen were likewise determined, and an effort was made to correlate the results with findings elsewhere in the State, especially where single crops had been raised for many years. Samples of all the crops and fertilizers used in connection with this work were analyzed.

The life-history work on *Empoasca mali* was practically finished, only a few points in its life history and whether or not it is parasitized remaining to be determined. The studies of *Macrosiphum granaria* were also about completed but work was continued to determine a particular point in its life history. The most serious invasion of *Brucophagus funebris* during the past season occurred near Duluth, where the year's field work on this pest was done.

Work on the plant-rust problem included studies of spore germination of a number of species and of the resistance and its nature of various host plants to parasitic fungi. In working for rust resistance some F₂ hybrids were grown and a study of the correlations of host characters was made. As a practical result of this work a high rust resistance has been united with a good quality of grain in wheat. Certain points in the life history of common wheat rust were also studied and determined.

In the fruit-breeding experiment, considerable progress was made in hybridizing and selecting plums, grapes, apples, strawberries, pears, and other fruits, and a study was made on natives and hybrids to determine the underlying principles of plant breeding, and to learn what constitutes hardiness. A statistical study of fruit characters was also conducted. Many thousand crosses have been made and the material on hand offers an unusually favorable opportunity for this line of investigation.

The work of the station under Hatch and other funds is more extensive than that under the Adams fund and is also very important. The veterinary department continued its work in virulent blood vaccination as a means of immunizing very young pigs against hog

cholera. Other activities included a test of the practical value of von Behring's antituberculosis vaccine, and work on swamp fever in cooperation with this department, principally on methods of diagnosis.

The department of dairy and animal husbandry studied the yield of milk and butter fat in relation to the feed consumed and conducted breeding experiments for maximum utility, symmetry, and uniformity in animals. Extensive pig-feeding experiments and feeding tests with silage for cows were also conducted.

The chemical department made an extensive study of wheats and flours, including composition, milling, and baking tests (Pl. II, fig. 2), and physical and chemical studies of the soils of the 25 demonstration farms of the station were carried on. The analytical data were checked up with pot tests, and the work is to be extended to field trials.

The work in agronomy and farm management was conducted along the lines of plant breeding, farm crops, crop rotation, cost of crop production, weed eradication, and farm management. Through the station's work, corn growing has been extended northward in the State. The weed eradication work consisted of studies of methods for the eradication of quack grass and Canada thistles. The farm management work, partly in cooperation with this department, included studies of farms in a number of localities to determine the cost of operation and net profit under different types of farming.

In botany and plant pathology the smuts of cereals were studied, and particular attention was given to the loose smuts of wheat and barley and the smut of corn. A preliminary study of forest, park, and shade trees was begun, and seed testing was carried on, about 3,000 lots of seed being tested during the year. Other lines of work comprised the building up of a flax-sick soil, the development of plants resistant to flax rust, studies of bean bacteriosis and early blight of the potato, and tests in orchard spraying.

The entomological department tried methods of controlling grasshoppers, oak borers, plum curculio, cutworms, and potato beetles. Grasshoppers were successfully controlled with arsenite of soda and molasses baits at a cost of about 30 cents per acre. Poisoned bran mash was most successful in the destruction of cutworms, and arsenate of lead sprays in combating the potato beetle. The adult potato beetle was found to require a more concentrated solution of arsenate of lead than the larva. In addition to this work, studies were made of the larch sawfly, which defoliates tamaracks in the State, and an elm-leaf pruner, which cuts off the leaves and terminal twigs of the elm. A species of tussock moth from eggs on a rosebush from France and parasites of the cutworm were also studied.

The department of horticulture conducted experiments in potato breeding, tested varieties and cultural methods, studied the rate of

tuber development, and compared methods of spraying for disease and insect control. Some tomato-breeding work was in progress and new varieties were compared with old or standard sorts.

The department of agricultural engineering pursued investigations on tile drainage and studied the value and possibilities of utilizing the peat lands of the State. Irrigation work was also carried on to determine the value of irrigation in Minnesota. A practical experiment was made to determine the minimum radii for the economical laying of tile curves with tile from 4 to 30 inches in diameter.

The experimental work in forestry was carried on under State funds and included wood preservation work in cooperation with the Forest Service and silvicultural work at the forest experiment stations at Itasca and Cloquet.

The principal work at the Grand Rapids substation included the improvement and building up of the station dairy herd to show what could be done in dairying with such animals as are found on the farms of northeastern Minnesota, the raising of a bacon breed of hogs in connection with dairy farming, the possibilities of specialized poultry keeping, and the improvement of the more important field crops in that section of the State. Tests with alfalfa indicated that the crop is well adapted to northeastern Minnesota, a stand being readily obtained without inoculation. At the Morris substation the work was mostly confined to getting the farm into shape. At Crookston about 430 acres were platted into two major practical farm rotations, one a 5-year and the other a 7-year scheme. The experimental work with field crops was reorganized during the year and the poultry work was continued along previous lines, but interrupted to some extent by building operations.

The extension work of the department of agriculture is provided for by a special State appropriation of \$25,000, with an additional \$2,500 for dairy extension work. A special corps of extension workers is maintained independent of the college and station. The extension work, however, is in a general way supervised by the heads of the station departments.

The following publications were received from this station during the year: Bulletins 117, The Cost of Producing Minnesota Farm Products, 1902-1907; 118, Potato Experiments and Studies at University Farm in 1909; 119, Poultry; 120, Rye Growing in Minnesota; 121, Orchard and Garden Spraying; 122, The Smuts of Grain Crops; and Wall Chart, Some Minnesota Insects and Useful Birds.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	14,997.99
Balance from United States appropriation, Adams fund	2.01
State appropriation	107,033.36
Total	137,033.36



FIG. 1.—YEARLING MULE COLTS OUT OF THOROUGHBRED MARES, WEIGHTS 654 AND 660 POUNDS.



FIG. 2.—YEARLING MULE COLTS OUT OF CLYDE MARES, WEIGHTS 770 AND 780 POUNDS.

A STUDY OF THE PRINCIPLES OF MULE BREEDING, MISSISSIPPI STATION.

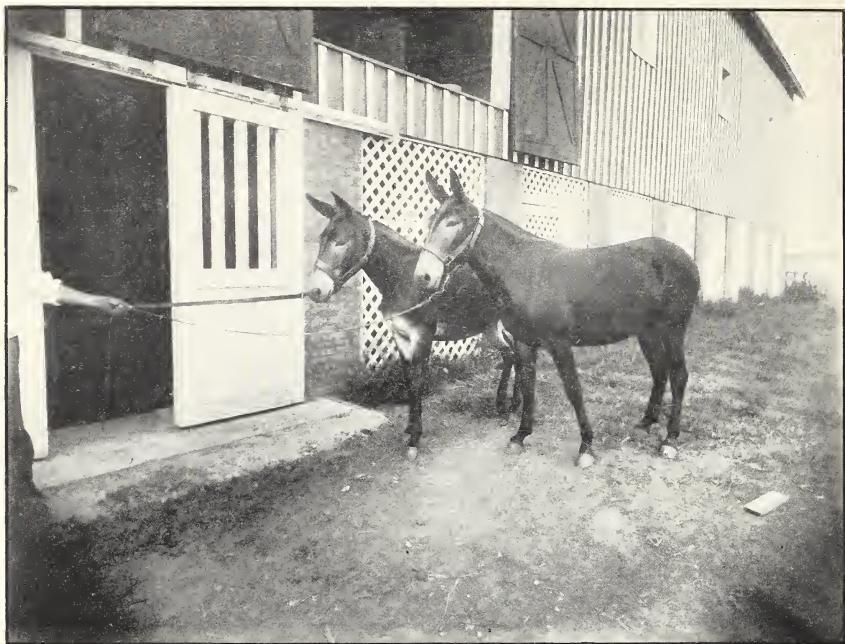


FIG. 1.—TWO-YEAR-OLD MULE COLTS, ON RIGHT OUT OF NATIVE MARE, ON LEFT OUT OF THOROUGHBED MARE, WEIGHTS 880 AND 780 POUNDS.



FIG. 2.—TWO-YEAR-OLD MULE COLTS OUT OF CLYDE MARES, WEIGHTS 1,100 AND 1,000 POUNDS.

A STUDY OF THE PRINCIPLES OF MULE BREEDING, MISSISSIPPI STATION.

The scope of the work of the Minnesota station is widening and the influence of the institution is extending to all parts of the State. The liberal support given by the State shows that the value of its work is receiving recognition.

MISSISSIPPI.

Mississippi Agricultural Experiment Station, *Agricultural College*.¹

Department of Mississippi Agricultural and Mechanical College.

J. W. Fox, M. S., *Director*.

Few changes occurred on the staff of the Mississippi station during the year. At its close, R. P. Hibbard, the bacteriologist, handed in his resignation, and later J. W. Fox, the director and agronomist, resigned, to take charge of a large tract of land for private parties, and he was succeeded as director by E. R. Lloyd, who will also continue to be animal husbandman, and as agronomist by J. R. Ricks, the assistant agronomist of the station. Since the close of the fiscal year James Lewis, the veterinarian, also resigned and was succeeded by E. M. Ranek. On March 5, 1911, one of the cattle barns of the station was destroyed by fire and about 70 head of stock were lost. Since then the construction of a new barn, 48 by 125 feet, with concrete drives and 200-ton hay capacity, together with a 160-ton concrete silo, was begun.

Among the Adams fund projects, progress was noted in the mule-breeding work and additions to the stock under experiment were made to include other breeds. (Pls. III and IV.)

In connection with the cottonseed meal project in charge of the bacteriologist and the dairyman, the bacteriological study of the blood, milk, and urine of the cows fed cottonseed meal was continued and was supplemented by studies with hogs. Fresh and stained blood was examined for changes in the leucocytes, specific gravity, percentage of hemoglobin, and other conditions. Examination was made of the urine for blood and of the milk for pus cells.

In the study of cotton anthracnose, a very complete investigation was made into the life history of the fungus *Colletotrichum gossypii*. Observations were made on stalks in the field to determine how long they would continue as a source of infection to the new crop, and some physiological and ecological studies of the fungus were pursued. The varieties entering into this work did not show an appreciable resistance to the disease.

The study of inheritance of different characters in cotton was confined to 4 varieties, but in addition 50 varieties were planted for

¹ Telegraph address, Starkville; express and post-office address, *Agricultural College*; freight address, A. and M. College Station.

observations regarding natural crossing and other characters. Numerous crosses between the most promising of these sorts were made to study the inheritance of the characters or qualities which made the varieties apparently better than others. Careful notes on the different plants used for crossing as well as on the different varieties were made and self-fertilized seed was secured from the plants. The analysis of factors concerned in earliness was taken up and the time and rapidity of fruiting, the relative amount of shedding of squares and bolls, the size of bolls, and other characters were studied.

The life-history studies on scale insects were carried forward and a bulletin on the subject was prepared. Considerable work was also done on pecan insects and the peach-tree borer, and a large amount of data was accumulated. Progress was further reported in the study of the life history of species of crayfish occurring in Mississippi and of the means for their control.

In addition to the Adams fund work, the entomologist studied the spread of the boll weevil in Mississippi and the causes for its movement at different rates in the various sections of the State. Much time was given to the study of the insect and the means of controlling it. A bulletin has already been published on the subject. Attention was further given to insects attacking the cowpea, and additions were made to the station collection of insect specimens.

The work in agronomy included variety, fertilizer, and culture tests with cotton, variety tests with corn, wheat, and forage crops, and cultural tests with alfalfa. A topping experiment with cotton was conducted, and it was shown that the plants topped July 15 gave a little better yield and were much earlier than those topped later. An application of 10 tons of barnyard manure per acre was found more effective in the prevention of rust in cotton than 400 pounds of kainit. An experiment was also conducted in combating the cotton worm which appeared about August 15 on the station farm. Twelve varieties of cowpeas and 5 varieties of soy beans were tested for yields of hay and seed.

The horticultural work of the station under the Hatch fund consisted of experiments with various fruits and ornamental plants, especially with strawberries, grapes, pecans, hedge plants, roses, and ornamental shrubs. Cooperative work along these lines was begun in different parts of the State. Two bulletins on this work were published during the year.

Poultry work was resumed by the station during the year and experimental work, including feeding experiments with cotton-seed meal as a source of protein for laying hens, inheritance of size of egg, and testing incubators under local conditions, was begun. Observations were also made on local supplies of feed for hens and chicks,

as compared with standard feeds. Some attention was given to insect pests and the means of their control in poultry houses. A very complete system of records for all breeding, egg laying, and experimental work was installed.

The department of animal husbandry carried on steer-feeding experiments to compare the value of feeding in stables or in the open and the profitableness of feeding silage, cottonseed meal, and cottonseed hulls. A test was also made of feeding small amounts of cottonseed meal to steers on pasture. In pig-feeding experiments various crops with and without grain and tankage and cottonseed meal were compared. From 1 to 4 pounds of cottonseed meal per day was fed without ill effects. In addition to this work, an extensive experiment was in progress on the cost of wintering brood mares and mule colts. The cheapest ration consisted of hay, silage, and cottonseed meal.

In dairying work was carried on to determine the relative value of soiling crops and purchased feeds, and in this connection a study of the cost of milk production was pursued. A comparison was also made of corn chops, wheat bran, rice bran, and rice polish for dairy cows.

The publications received from this station during the year were as follows: Bulletins 128, Inspection and Analyses of Cottonseed Meal; 137, Inspection and Analyses of Commercial Feeding Stuffs; 138, Inspection and Analyses of Commercial Feeding Stuffs; 139, Boll Weevil in Mississippi, 1909; 140, Cotton Diseases in Mississippi; 140-B, Cotton Diseases in Mississippi; 141, Control of Diseases of Fruits, Vegetables, and Flowers; 142, Inspection and Analyses of Commercial Fertilizers; 143, Inspection and Analyses of Cottonseed Meal; 144, Inspection and Analyses of Commercial Feeding Stuffs; 145, Inspection and Analyses of Commercial Feeding Stuffs; and Circular 32, Inspection and Analyses of Commercial Fertilizers.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriations for substations	29,150.00
Fees	306.00
Individuals	5,266.96
Farm products	7,280.89
Miscellaneous	199.00
Total	72,202.85

The Mississippi station during the year made general progress under its new organization and placed its work on a stronger and more promising basis.

MISSOURI.

Missouri Agricultural College Experiment Station, Columbia.

Department of the College of Agriculture and Mechanic Arts of the University of Missouri.

F. B. MUMFORD, M. S., *Director.*

The Missouri station during the past year extended its organization by establishing three new departments—farm management, poultry, and forestry—and increased its working force by the appointment of a number of assistants. The new buildings recently completed were the veterinary laboratory, costing \$30,000; new dairy barn, \$12,000; implement and wagon barn, \$2,000; poultry plant, \$2,500; hog-cholera serum laboratory, \$1,500; and cattle sheds, \$300. A new agricultural chemical building has been authorized, and the station purchased 80 acres of land for the use of its horticultural department.

The following appropriations in which the college and station are jointly interested were made by the legislature for the biennium beginning January 1, 1911: Outlying experiments, \$15,000; soil survey, \$12,000; manufacture and distribution of hog-cholera serum, \$25,000; agricultural laboratories, \$8,000; agricultural library, \$2,000; animal husbandry, \$12,000; dairy husbandry, \$5,000; experiment station, \$20,000; dairy barn, \$12,000; for completing veterinary building, \$5,000; and agricultural chemistry building, \$60,000.

A series of research bulletins was inaugurated during the year.

General progress was made during the year in the Adams fund work of the station. The study of the factors influencing the properties of milk was continued, and the project on the use made of food by steers at different ages and at different conditions was practically concluded as originally planned, with the exception that considerable analytical work remained to be done. Some of the results obtained in each of these studies were published.

The work on age as a factor in animal breeding was carried on with sows of different ages. The investigation has now proceeded to the fourth generation, and the offspring were all reared upon the same rations; and the weights, measurements, and gains were tabulated.

In the study of the dormant period of trees it was found that hard freezing or extreme drought will force the development of buds, and that late going into dormancy will prolong the rest period of trees and thus protect against late spring frosts. The results further showed that cultivation, pruning, and the application of fertilizers delays ripening of wood in the fall and consequently extends the dormant period later into the spring. The work on orchard fertilization in its relation to disease resistance was conducted mainly on thin soils, and excellent results were secured during the past very

dry year. In connection with this investigation a study was made of the osmotic strength and freezing point of sap as influenced by fertilizers and as related to the dormant period.

A preliminary report was prepared, giving some of the results secured in the investigations on the powdery mildews, and the work was continued during the season. Attention was mostly given to the mildews of wheat and barley to determine susceptibility and the relation of light and other factors to infection.

In the project on immunizing hogs against cholera and swine plague a study was made of the blood in relation to its immunizing power. Blood of normal, diseased, and hyperimmune hogs was used and its relation to determining the potency of serum was considered.

The work conducted under Hatch and other funds was very extensive and nearly every department was represented in it. In animal husbandry attention was given to summer feeding of cattle and the results of five years' work published. Data were collected on wintering cattle, feeding silage to beef animals, and other feeding problems. A rotation of forage crops for pork production, including blue grass, clover, rape and oats, corn and cowpeas, and rye was tested, and the cost of production for each crop or combination was worked out. Attention was further given to the influence of feeding on the condition of cattle at the beginning of the feeding period. Experiments with nitrogenous supplements fed with corn showed them to be more efficient and profitable when fed during the latter part of the feeding period than when fed continuously throughout. Observations were also made on the comparative profitableness of fattening yearlings and 2 and 3 year old cattle. A mule-feeding experiment was begun, and experiments in feeding early lambs were carried on.

The department of agronomy conducted work in corn breeding for high and low protein, studied barrenness in cornstalks, tested varieties of corn, and carried on wheat-breeding and selection experiments. Several crossbred wheats have been produced that are more productive than either parent, one variety, Missouri 44, having averaged 8 bushels more per acre than the two parent sorts. Variety tests of soy beans and cowpeas were in progress, and experiments with alfalfa were conducted at the station and at a number of other localities. Soil-management work was pursued on outlying experiment fields to determine the fertilizer treatment required, showing that for the majority of soils in the State nitrogen and phosphoric acid were the limiting factors of crop production. Corn-breeding work was carried on at the station by the ear-to-row method.

The department of horticulture, in a comparison of fall and spring planting of fruit trees and ornamentals, secured results favorable to fall planting. Tests were also made of Ben Davis and Grimes

Golden apples grafted on strong, medium, and weak stocks, and also of scions from best and poorest bearing trees to determine the value of the selection of scions based on the fruitfulness of the parent stock. Selection work with strawberries and tomatoes was in progress and some experimental work in canning vegetables was undertaken. Asparagus selections were made for size of stalk and resistance to rust. An experiment on hardiness and phenology of northern and southern peaches of the same varieties, as well as of a number of species of native forest trees, was completed, and the results were about ready for publication. The work was carried on for 10 years, and all varieties had apparently attained a common phenology. Considerable demonstration work was done in peach and apple orchards of the State, and marked results demonstrating the value of proper orchard management were secured.

In plant pathology, investigations were made on the grain smuts with special reference to the influence of temperature of smut infection. In addition, a leaf spot of tomatoes having appeared in a certain part of the State was studied.

The entomologist of the station studied a number of insect pests including bagworms, striped cucumber beetle, hickory-twig borer, San José scale, chinch bug, the fall army worm, and other pests. The work on bagworms and on the distribution of San José scale was prepared for publication.

The veterinarian continued work on tuberculosis, giving special attention to testing the von Behring method of eradication. He also studied the possibility of swine infection from cattle, and especially how soon the infection may be recognized in pigs. The possibility of conserving hog-cholera serum in a dried form was also investigated. Under State funds active work was pursued in the production of hog-cholera serum, for which at certain times there was a great demand.

The dairyman studied the effect of feeding cottonseed meal to dairy stock, the influence of heavy and light feeding of heifers, and early and late calving on the mature animal. The nutrients required for milk production were studied and the data for five Jerseys were completed and published in bulletin form. The experiment was broadened to include Holsteins, Ayrshires, and Shorthorns, and the work includes digestion experiments which run for a year for each lot.

The station carried on in numerous localities a large amount of work supported by State funds. This endeavor was mainly along the line of demonstration work, although some experiments on soils, alfalfa, selection and breeding of various grains, and testing new varieties were carried out. In the Ozark Mountain region experiments were conducted on the improvement of pastures with a view

to developing the dairy industry. In 1910, 366 men in 105 counties cooperated with the station in experiments to determine the best methods of farming, and the results of this work demonstrated that alfalfa can be successfully grown in every county of the State, and that the best varieties of corn for Missouri are Boone County White, Reid Yellow Dent, Johnson County White, and St. Charles White.

The publications received from this station during the year were as follows: Bulletins 85, Sup., Inspection of Commercial Fertilizers; 87, Cooperative Variety Tests of Corn—Variety Tests of Corn at Columbia; 88, Soil Management in the Ozark Region; 89, Forest Conditions of the Ozark Region of Missouri; 90, Fattening Cattle on Blue Grass Pasture; 91, Inspection of Commercial Fertilizers; 94, Factors Affecting the Per Cent of Fat in Cream from Farm Separators; 95, Pork Production with Forage Crops; 96, Report of the Director for the Year Ended June 30, 1910; Research Bulletins 1, An Experimental Study of the Rest Periods in Plants; 2, A Study of the Cause of Wide Variations in Milk Production by Dairy Cows; 3, Soils of the Ozark Regions; Circulars 39, The Seeding of Cow-peas; 40, The Seeding of Alfalfa; 41, Directions for Testing Milk on the Farm; 42, The Seeding of Clovers and Grasses; 43, Wheat Growing in Missouri; 44, Feeding for Milk Production; 45, Selecting and Judging Corn; 46, Factors Influencing the Yield of Oats; and 47, Raising Calves on Skim Milk.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation, including balance from previous year -----	5,569.16
Fees, including balance from previous year-----	16,519.40
Farm products, including balance from previous year-----	6,115.35
Miscellaneous-----	46,919.62
Total-----	105,123.53

The Missouri station continues to carry on the scientific investigation of agricultural problems of the greatest value to the State and to disseminate the practical results of its experimental work by a variety of means.

MONTANA.

Montana Agricultural Experiment Station, Bozeman.

Department of the Montana College of Agriculture and Mechanic Arts.

F. B. LINFIELD, B. S. A., *Director.*

Changes in the staff of the Montana station during the year were confined to the appointment of H. B. Bonebright to take charge of agricultural engineering work. The last legislature made the fol-

lowing appropriations for 1912: Maintenance of the station at Bozeman, \$22,500; improvement at this station, \$4,000; work in dry farming, \$20,000; maintenance of the Fergus County substation, \$3,000; and maintenance of the horticultural substation, Ravalli County, \$2,000. The station chemist was designated as State chemist in food and health matters, with an appropriation of \$1,500 per year; and a dairy inspector and instructor to be located at the college was authorized, with an appropriation of \$3,000 per year. At Bozeman, \$10,000 was used during the year in the erection of greenhouses. (Pl. V, fig. 1.) At the Fergus County substation a new horse barn was completed and other improvements in the buildings were made. A new barn was also constructed at the horticultural substation.

The Adams fund work made steady progress. The life history of the oyster-shell scale was studied in the laboratory and in the field. Observations on the number of broods in Montana were made, and a mite attacking the scale was studied in cooperation with Iowa station. The efficiency of different substances used in combating the insect was determined. Among sugar-beet insects, the army cut-worm was studied with special reference to its control through parasites and other predaceous enemies. Work on the life history of the root louse was completed, as was also the study of the beet aphid, which was differentiated from the European species brought over for comparison.

The investigation of the physiological effect of arsenical compounds was continued with vegetables and trees, and substances were tried as to their capacity of counteracting the injuries resulting from this class of insecticides. A preliminary report on this project has been published.¹

The soil-moisture project, as such, was closed out and the results secured prepared for publication in two bulletins. This general line of work was reorganized to include bacteriological and chemical soil studies, which made good headway.

A preliminary report on the Montana apple canker was prepared and a report on anthracnose was made ready for the press.

Work on the temperature conditions of hatching eggs in the incubator and under the hen was carried forward, together with studies of other phases of incubation. A self-recording apparatus for getting temperature records was installed to facilitate the work and to give greater accuracy.

In studying the effect of various factors upon wool considerable attention had to be given to devising methods. A large number of samples of wool were gathered and studied with reference to strength and other qualities as affected by methods of handling and treating



FIG. 1.—NEW GREENHOUSE ATTACHED TO AGRICULTURAL BUILDING, MONTANA STATION.



FIG. 2.—EXPERIMENTAL STEER-FEEDING PLANT, CONSTRUCTED OF HOLLOW TILE WITH CEMENT STUCCO FINISH, NEBRASKA STATION.

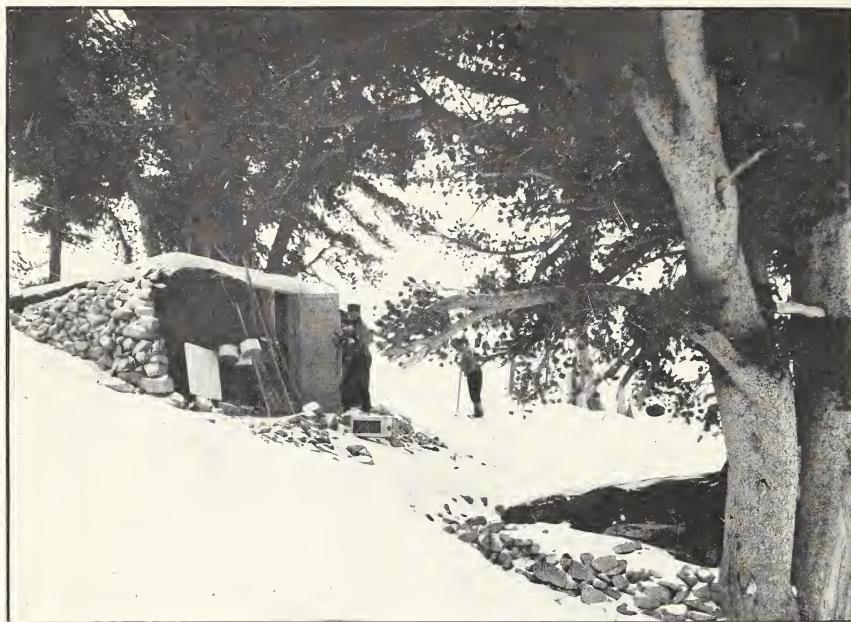


FIG. 1.—REFUGE CAMP AND HEADQUARTERS FOR SNOW MEASUREMENTS ON MOUNT ROSE.



FIG. 2.—SUMMIT STATION, MOUNT ROSE OBSERVATORY (ALTITUDE, 10,800 FEET).

METEOROLOGICAL AND CLIMATOLOGICAL OBSERVATIONS, NEVADA
STATION.

sheep. In conjunction with this investigation crossing experiments were carried on with range sheep.

The results secured in the study of cement were published in a bulletin. The causes of disintegration and the means of overcoming them were the principal topics of this investigation, which is to be carried further.

Under Hatch and other funds the department of entomology in co-operation with this department continued its work on the spotted-fever tick. In addition a new grain aphid was studied, and spraying experiments for devising means of combating grasshoppers and insects attacking cabbage, sugar beets, and apples were carried on.

Studies of pear blight were made mostly under the State horticultural inspection law and a report on this work was made in Circular 2 of the station. Culture experiments were conducted with celery and tomatoes, special attention being given to methods of blanching celery and of growing celery seed, and to the irrigation of tomatoes on heavy soil. Pruning experiments with cantaloups and cucumbers showed that the pruned plants were relatively advanced in their season of growth. Experiments in pruning were also carried on in the station orchards on young and old trees. With small fruits, variety tests were continued and studies were made of methods of winter protection. The orchard work conducted at the substation in the Bitter Root Valley included variety tests and methods of keeping up soil fertility by clean culture, potato cropping, small cover crops, field peas, the use of clover left on the ground as hay, and the growing of peas and beans.

Feeding experiments were conducted by the department of animal husbandry with different kinds of stock. In experiments with dairy cows clover silage was compared with clover hay and corn silage, corn meal was compared with shorts in a mixed ration in pig feeding, and feeding tests with beef cattle were conducted to determine cost of production. The inbreeding of pigs was continued and the results have shown the weakening of offspring and the splitting up of colors.

Among other work the department of chemistry carried on studies with alkali and other infertile soils in cooperation with the department of agronomy. Pot experiments were made with soil deficient in available lime.

The experimental work in agronomy on the station farm was continued along the same general lines as the year before. This department has charge of the demonstration work in different parts of the State, including 18 localities. The agronomist also cooperates with this department in work on crop rotations, including rotations with sugar beets and in cereal studies. It has been found that blue hull-less barley is successful in different regions of the State, and 5 acres

of this crop were grown at the station. Guy Mayle barley has proved especially good for dry farming, and Banner oats and Stanley wheat have also been found promising for the State.

The veterinarian continued work on contagious abortion, investigated infectious anemia in horses, and studied the effect of ticks on different animals.

The extension work is organized under the college, and the station force cooperated in this work by giving lectures at farmers' institutes, public-school teachers' institutes, and high schools.

The following publications were received from this station during the year: Bulletins 79, Seventh Annual Report of the State Entomologist of Montana; 80, Ornamental Trees and Shrubs for Montana; 81, The Destruction of Hydraulic Cements by the Action of Alkali Salts; Circulars 5, Alfalfa Management in Montana; 6, Flax Growing in Montana; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation-----	44,353.99
Fees-----	6,858.19
Miscellaneous-----	9,432.66
Total-----	90,644.84

The Montana station is working closely in the interests of the agricultural people of the State. Its work along all lines is much appreciated, and the large number of settlers coming into the State has caused an increase in the demand for information. The research work of the station is being placed on a stronger basis.

NEBRASKA.

Agricultural Experiment Station of Nebraska, Lincoln.

Department of the University of Nebraska.

E. A. BURNETT, B. S., *Director.*

The Nebraska station made general progress in its lines of work, although the severe dry weather of the year interfered with some of the experiments, especially those conducted in the drier parts of the State. At the newly established substations improvements were made and experimental work started. A house and barn costing \$6,500 were constructed and other improvements amounting to about \$2,500 were completed at the Valentine substation, and improvements, including a barn, were made at the Scotts Bluff substation at a cost of about \$2,000. At Lincoln the steer-feeding plant (Pl. V, fig. 2) was completed at a cost of about \$11,200, and at the North Platte substation there were

erected a residence at a cost of \$4,550, a gravity water system at \$2,000, and concrete sheds and hog houses and minor buildings at \$3,500. The State appropriated \$15,000 for a new substation, \$15,000 for the erection and operation of a serum plant at the main station, \$5,000 for the station entomologist as State entomologist, and \$3,000 for the station botanist as State botanist, \$35,000 for agricultural extension, and \$85,000 for a new building for agricultural botany, horticulture, and entomology. Since the close of the fiscal year J. H. Frandson was placed in charge of dairy husbandry and C. W. Pugsley in charge of agricultural extension and farm management.

No new Adams fund projects were entered upon during the year, but progress in the established lines of work was reported. The relation of conformation and quality to gaining capacity was studied in six groups of 8 steers each, comprising rough and smooth types and specimens from dairy breeds. Rations were fed to compare different sources of protein, and the effects of the use of clover in place of silage when fed with corn and alfalfa were observed. Individual records were kept of the feed consumed and the gains made. About 40 calves were reared under similar conditions for use in the investigation.

Work on the effect of soil moisture on winter injury of fruit trees was limited to walnut, peach, and apple trees. The degree of low temperature at which fruit trees are injured was studied, and its influence on the upward flow of the sap was investigated. Special apparatus was constructed for the determinations. Some work along this line was also done with raspberries.

In connection with the project on heredity in plants, color inheritance in beans and corn, and latent inheritance in crossing black and white beans were studied. Observations were made on the color and the shape of both the plant and kernels in corn, together with correlation studies. Some work along this line was also done with gourds, balsams, nasturtiums, snapdragons, portulacas, geraniums, and petunias.

The plant-disease project included an investigation of a new form of dry rot of potatoes discovered in western Nebraska and the study of the life history of the causative organism. It was found that this dry rot is largely a storage trouble and that the fungus can only affect tubers which have been injured. Work was also pursued on bundle blackening of the potato and on potato scab.

In studying the composition of humus as affected by climate, samples were examined from the western half of the United States and Canada. These samples, studied under a method worked out by the station, showed that no soils in the humid or semiarid regions of Nebraska have a high percentage of nitrogen in the humus. The influence of different methods of cropping in this relation and the

effect of humus at different depths and on different types of soil were also investigated.

Work on the soils of the transition region included studies on the hygroscopic coefficient and a means of determining it readily. The minimum water capacity of soils was determined, and vegetation experiments in 6-foot cylinders were carried on with wheat, beans, milo maize, and desert plants under different moisture conditions to determine the moisture content of surface soil at which plants will die. Advantage was taken of the prevalence of dry weather to carry this work well toward completion. In connection with the hygroscopic studies, observations were made on the upward and downward movement of soil moisture.

Good progress was made in the studies on transpiration, or the relation between leaf area in the corn plant and the water used in growth. The methods for carrying on the work have been ingeniously worked out, and the study as carried on included transpiration under different conditions of soil fertility and adaptation of varieties or strains in its relation to transpiration. In addition to this work, seepage and run-off were determined in lysimeter experiments, and corn, sweet sorghum, and milo maize were included in the investigation. A study of the relation of water loss through transpiration to weather factors—wind, humidity, and temperature—indicated that transpiration follows evaporation from free water surfaces quite closely. The relation of the humidity of the air to the quantity of water required to produce 1 pound of gain was studied in experiments conducted in the greenhouse with the factor of humidity under control.

Work on close breeding in maize included five different lines of investigation for the purpose of studying different phases of the subject. These experiments on inbreeding brought out the elemental strains of the variety, resolving it into its original elements, and showed that the vigor of the plant is impaired in a varying degree. Field tests conducted with the inbred progeny showed that the first inbreeding reduced the yield about one-half.

The results of studies on the competition of cereals showed that under a thick rate of planting a certain percentage of the plants were crowded out and failed to produce seed. A larger percentage of plants originating from shrunken seed than of those coming from plump seed were crowded out, thus indicating the possible importance of natural selection in maintaining the vigor and yield of cultivated cereals. With corn a higher yield was obtained with seed grown under thick planting than with seed from a thinly planted crop.

In his hog-cholera studies the veterinarian used horse-blood serum for hyperimmunization on over 1,400 pigs with a loss of $7\frac{1}{2}$ per cent.

In connection with this work, studies were made on the potency of the serum. Owing to the lack of typical swamp-fever cases during the early summer the work on this disease could make but little progress and was limited to a study of certain conditions of the blood as causative factors.

Under Hatch and other funds the entomologist worked out the life history and studied the parasites of the bull-pine sawfly. He also worked on melon aphid, strawberry leaf roller, and a sawfly affecting the strawberry. The results of his work on the bull-pine sawfly and the melon aphid are reported in detail in the last annual report of the station.

The agronomist tested high-yielding ears of corn selected by farmers, about 40 ears having been selected and sent in as high yielders. Ear-to-row breeding work was begun with corn selected according to four types, and experiments were also carried on with thick and thin planting in rows and with silage corn. Seven hundred samples of oat varieties were grown on small plats under similar conditions. A detailed study of the progeny showed that many samples bearing the same variety name were entirely different types, while others bearing different names were identical. Studies on comparative yields and relative nitrogen content during successive years on 224 small permanent plats sown each year to a uniform wheat and all receiving uniform treatment showed that plats giving comparatively high yields one year did not necessarily give high yields in other years. In connection with this study of standardizing plats it has been shown conclusively that the error in comparative data can be much more reduced by a duplication in small plats systematically arranged over a field than by increasing the size of the plats.

In horticulture the experiments in orchard management with reference to clean culture, cover crops, and sod were continued and some hybridizing work was done with apples on groups of different kinds. Demonstration work over the State in spraying showed that profitable crops of apples can be grown where proper care is given to the trees and careful spraying methods are followed. The results of the more recent spraying demonstrations in apple orchards were published.

The publications received from this station during the year were as follows: Bulletins 115, The Determination of Humus; 116, Economical Beef Production; 117, Growing Feeder Steers in Western Nebraska; 118, Growing Crops in Western Nebraska; 119, Spraying as an Essential Part of Profitable Apple Orcharding; 120, Alfalfa Management; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation for substations, including balance from previous year-----	23,249.31
Farm products-----	35,808.33
Balance from previous year-----	8,688.20
Total-----	97,745.84

The Nebraska station is in a thoroughly prosperous condition, and its work is much appreciated throughout the State. Its investigations in a number of lines are conspicuous for their excellence.

NEVADA.

Nevada Agricultural Experiment Station, Reno.

Department of Nevada State University.

J. E. STUBBS, M. A., D. D., LL. D., *Director.*

During the past year the Nevada station did not enter upon the study of new problems but confined its work to the projects already in hand. The State appropriated \$3,000 for general station expenses and \$2,000 for meteorological work on Mount Rose. (Pl. VI, figs. 1 and 2.) The live-stock equipment of the station was increased by the purchase of some pure-bred cattle and sheep of different breeds. The inspection work under the station is provided for by the State for the current biennium, as follows: For food and drug inspection, \$12,000; for the inspection of weights and measures, \$4,000; and for the maintenance of the State Hygienic Laboratory at Elko, \$10,000.

Work on most of the Adams fund projects was actively pursued during the year. In the investigation on poisonous plants a considerable quantity of poisonous extract obtained was studied as to its composition and chemical reactions. The matter of antidotes was also given consideration.

The meteorological investigations were continued and observations were made on snow with reference to depth, density, and evaporation, and the effect of forests, different kinds of trees, broken ground, and of sunlight was studied. A temperature survey of the Truckee Valley was made to determine the possibility of successfully heating orchards for the prevention of injury from late spring frosts in this particular region, and other studies of this nature were made in determining the possible forecasting of frosts from mountain tops. Considerable work was done in perfecting apparatus and instruments for making different meteorological records. Efforts were also made to ascertain the quantity of seasonal moisture in the mountains available for irrigation.

A paper was prepared during the year on the food of the parasites of the codling moth after oviposition, the relation of their food to their longevity, and their reproduction. The life histories of some of these parasites were worked out and written up and new forms were described. In connection with studies of the feeding habits of the parasites numerous photographs were taken with apparatus specially devised by the station for such purposes.

Other work under the Adams fund included studies of equine anemia with reference to its effect on the bone marrow, the blood, and the liver; chemical studies of certain constituents of the alfalfa plant; alfalfa breeding work; and a study of native species of *Trifolium*. A paper on the intracellular bodies associated with equine anemia has been published.¹

Under the Hatch fund the department of botany, horticulture, and forestry confined its work to established lines, including studies of native plants of economic importance, orchard heating experiments for the prevention of injury from late spring frosts, and trials of different species of forest trees. The botanical collection of the station now includes many seed samples of native clovers, lupines, and other native species of value economically. The orchard heating experiments resulted in successfully encountering a temperature of 22° F. on May 8, and in demonstrating the necessity of using in oil heaters a fuel of a certain grade and quality. Up to the present time the station work in forestry has been preliminary. Observations with regard to the economic possibilities of certain species of forest trees were made during the year and forest nursery work was carried on with species of fir, spruce, and pine. The results with *Pinus scopulorum* were especially promising.

The department of entomology continued its studies of certain cut-worms infesting alfalfa and completed the life-history work of one of the species. The work of the department further included studies of the food of certain mosquitoes and experiments on combating the European elm scale. Fumigation experiments were made with hydrocyanic-acid gas to determine its efficiency in the control of the Mediterranean flour moth. A native parasite of the flour moth was found and studied. Attention was also given to the potato eelworm, with reference to local conditions, and to alfalfa weevils.

The work in agronomy was conducted along the same lines as heretofore and included sugar-beet experiments and evaporation and irrigation experiments in cooperation with this department, together with work on alfalfa and in potato breeding. The alfalfa experiments in progress included methods of irrigation, culture, and variety tests.

¹ Proc. Amer. Vet. Med. Assoc., 48 (1911).

In animal husbandry, lamb breeding was continued and feeding experiments were carried on with pigs and sheep. The pigs were kept on pasture during the summer and fed alfalfa silage as a part of the ration during the winter. The sheep were fed alfalfa silage alone, which proved to be a good ration for breeding ewes. A record of the cost of butter-fat production on different feeds was also continued.

The activities of the department of chemistry consisted principally of routine work and included 35 water analyses, 135 soil analyses, and 75 analyses of a miscellaneous character. A report on gypsum was published in the last annual report of the station.

The dry farm established at Elko has a State appropriation of \$10,000 for the current biennium. The control of this farm is in the hands of a board on which the station is represented. The work conducted there during the past year consisted mainly in testing varieties of spring grain.

The following publications were received from this station during the year: Bulletins 72, Annual Report of the Board of Control, the Director, and the Members of the Station Staff, 1909; 73, A Neglected Field in Photomicrography; 74, First Annual Report of the Department of Food and Drugs Inspection for the Year Ended December 30, 1910; 75, The Sugar-beet Industry in Nevada; 76, The Potato Eelworm (with Italian edition); 77, Fixing Standard Weights and Measures; Circular 8, Artificial Coloring in Food Products; 9, Use of Benzoate of Soda and Cereals in Meat Products; 10, Ice-cream Cones; and 11, Vinegar.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	13,890.64
Balance from United States appropriation, Adams fund-----	1,109.36
Miscellaneous, including balance from previous year-----	5,204.85
 Total-----	 35,204.85

In accordance with a growing demand for agricultural information in the State and a greater appreciation of the station's efforts, the amount of work at the institution increased materially during the past year.

NEW HAMPSHIRE.

New Hampshire College Agricultural Experiment Station, Durham.

Department of New Hampshire College of Agriculture and Mechanic Arts.

J. C. KENDALL, B. S., *Director.*

A new dairy building for the college and station was completed during the year. For the ensuing biennium the legislature appro-

priated for the college and station \$5,000 for a horse barn, \$7,000 for establishing a department of forestry, \$3,000 for live stock, \$1,500 for publishing information bulletins, \$5,000 for extension work, and \$10,000 for general running expenses.

Under the Adams fund the station conducted work on eight different projects. In studying the availability of potash in certain soils field work was conducted on about 30 series of plats, but the unusually dry season caused the results to be indefinite. In the laboratory the effect of different substances on the availability of the natural potash in soils was studied, and some phases of the work were brought to completion.

Work on the fruit-spot disease of the apple brought out further particulars in regard to the life history of the fungus. Studies of leaf spot centered on the differentiation of apparently two species of fungi and the determination of the causative organism. A study of the fruit rot of tomatoes was begun, special observations being made on the various stages of the disease and of different factors, with a possible bearing on its development.

The sheep-breeding work was in its fourth year, and up to the end of the year 270 sheep of different generations had entered into the investigation. Detailed records regarding measurements, wool production, inheritance of wool color, quality of milk, and lamb production were made. Information regarding this project was published during the year in Bulletin 151 of the station, and a preliminary report on the work was prepared in addition.

Work on the apple maggot progressed well toward completion and the results are to be published during the ensuing year. Information with reference to the control of the pest was published in Circular 14 of the station and the details of the project were discussed in Bulletin 151.

The project on fruit-bud formation was continued, and data of practical importance were secured. The progress of this investigation for the three years ending with 1910 was summarized during the year in Bulletin 153.

The investigation of heredity in vegetables and other plants was continued with squashes, muskmelons, strawberries, and carnations. With squashes and muskmelons close approximation of Mendel's law was secured in most cases. (Pl. VII, figs. 1 and 2.) With strawberries records were made of the leaves and fruit of over 900 plants in continuation of correlation studies.

During the year the work carried on with Hatch and miscellaneous funds was placed on a project basis. The department of agronomy has accumulated a large amount of data in variety tests with corn in progress for several years. Fertilizer tests were made with corn grown for silage, and definite results were obtained. An ear-to-

row test of corn conducted since 1907 was continued and has resulted in a marked variation in yield among the different varieties. Fertilizer tests on grass lands to determine the effects of various fertilizer elements on the yield of hay on the boulder clay type of soil were carried on as previously outlined. The results of five years' work indicated the value of nitrate of soda for top-dressing on this kind of soil. Pasture-improvement work was conducted on six plats, and experiments on soil inoculation for leguminous plants were in progress.

The department of botany carried on spraying experiments with Bordeaux mixture and various lime-sulphur washes. A number of insecticides were applied with the lime sulphur to determine their comparative efficiency and their tendency to injure the plants.

The entomological department made considerable progress in adding to its economic collections, studying the blister mite, apple leaf-hopper, and other apple insects, as outbreaks of these pests occurred, and in making observations with reference to the repression of black flies, deer flies, and midges.

In animal husbandry a sheep-feeding experiment was completed and the results published as Bulletin 152 of the station. The principal feature of this work was the comparison of clover hay and of hay consisting of timothy and native grasses for sheep and lamb feeding, together with a study of the value of turnips in the ration. Work relating to the eradication of the stomach worm in sheep was continued during the year.

The chemist, among other lines of work, continued studies on the liming of soils. The results secured in the preliminary tests gave no evidence that lime was needed on the soils under experiment.

In horticulture observations were made on varieties of plums with reference to pruning, blossoming, time of bearing, yielding capacity, etc., and a variety test of apples was carried on in an orchard with part of the trees 5 years and part 9 years old. Work with carnations and lettuce was closed out during the year and fertilizer experiments with potatoes were begun. An orchard survey of the State was carried forward as an extension feature.

The station is carrying on cooperative experiments with farmers in hay culture and with this department in conducting farm surveys. The members of the station staff have assisted to some extent in farmers' institute and extension work.

The following publications were received from this station during the year: Bulletins 148, Results of Seed Tests for 1910; 149, Results of the Feed Inspection for 1910; 150, Results of Fertilizer Inspection for 1910; 151, Twenty-first and Twenty-second Reports; 152, Feeding Sheep and Lambs—Clover Hay *v.* Native Hay, Turnips *v.* Dry Ration; Circulars 8, The Box Pack for Apples; 9, Alfalfa in

New Hampshire; 10, Breeding and Selection of Corn; 11, Horticultural Information—How to Obtain It; 12, The Purchase and Home-mixing of Fertilizers; and 13, A Few Notes on Lime for Agricultural Purposes.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15, 000. 00
United States appropriation, Adams Act-----	15, 000. 00
Miscellaneous -----	5, 381. 03
Total-----	35, 381. 03

The work and affairs of the New Hampshire station are conducted in a systematic manner. A progressive step has been made in the recognition of college, station, and extension work as three distinct lines of endeavor, and this taken with the increase of extension work provided by a new appropriation will be of material benefit to the station.

NEW JERSEY.

New Jersey State Agricultural Experiment Station, New Brunswick.

At Rutgers College.

J. G. LIPMAN, Ph. D., *Director.*

New Jersey Agricultural College Experiment Station, New Brunswick.

Department of Rutgers College.

J. G. LIPMAN, Ph. D., *Director.*

During the past year the New Jersey stations suffered the loss of their director, Dr. E. B. Voorhees, who died June 6, 1911, and who has since been succeeded by Dr. J. G. Lipman. After the close of the year, A. W. Blair of the Florida station was appointed associate chemist to aid in investigations in soil chemistry, and H. R. Lewis was placed in charge of the newly established poultry department. Several changes in assistants were also made during the year.

The State legislature at its last session appropriated \$15,000 for buildings and equipment, and \$3,000 annually for maintenance of a poultry department. Rapid progress was made during the year in erecting poultry structures and in organizing experimental work. The legislature also appropriated \$20,000, of which \$11,000 was made immediately available for buildings and equipment and \$3,000 annually for maintenance of experiments in floriculture. The stations also profited by an annual appropriation of \$3,000 from the State for investigations in plant pathology, particularly for the study of the chestnut blight. M. T. Cook, formerly of the Delaware station, was recently chosen pathologist. Two special funds, one of \$2,000 per annum for the study of diseases of bees, in particular foul

brood, and \$10,000 for the study of live-stock problems, mainly the suppression of tuberculosis, in cooperation with the State board of agriculture, were to a large extent administered by the stations. A department of dairy husbandry was established with A. S. Cook, formerly of the Dairy Division of this department, in charge. The horse barn, dairy barn, two silos, and several smaller structures were destroyed by fire July 11, 1911. The loss, amounting to about \$25,000, was covered by insurance. Rebuilding on a better plan has already begun.

The Adams fund work, as heretofore, was confined to studies in soil chemistry and bacteriology and plant breeding. The work in soil chemistry and bacteriology has been well developed, and during the past year included studies on the accumulation and utilization of atmospheric nitrogen and on the availability of nitrogenous fertilizer materials. In connection with these lines of work, studies were made of the accumulation of nitrogen in the soil by means of green manures, the efficiency of different methods of inoculation of legumes, the influence of lime on nitrogen transformation in the soil, and the reciprocal relations of legumes and nonlegumes when grown together. Extensive laboratory and pot experiments on ammonification were made, with the result that a very satisfactory bacteriological method for determining the availability of organic nitrogenous fertilizers was worked out, and much light was thrown upon the conditions which control ammonification and nitrification in the soil.

In the plant-breeding work attention was given to heredity, toxicology, sap circulation, and shading and other conditions of environment. Work on heredity was principally pursued with the view to determining rules of inheritance, and to this end stress was laid upon the behavior of tomatoes in their first generation. This work has been in progress for several years and was conducted on an extensive scale. Breeding work similar to that with tomatoes was also extended to fruits. Work was also pursued in breeding types of eggplant, with particular emphasis upon the characteristics of a hybrid of an American and a Chinese species. Other truck crops considered along similar lines were okra, peas, peppers, gourds, and bush and vine varieties of squashes. Work in plant toxicology was begun and a bulletin was published upon Bordeaux injury to peaches. The study of plant sap circulation was limited to the sweet potato vine, and plant shading was studied in the greenhouse preparatory to more extended work in the field. The main feature of other plant environment work was a study of the effect of various conditions of light, heat, and moisture on the development of certain parts in the early growth of different plants.

In addition to the Adams fund investigations in plant breeding some work was done under the Hatch fund in fixing certain of the more promising sorts of beans, sweet corn, tomatoes, and eggplants secured in the breeding investigations.

The stations continued to give considerable attention to various features of peach growing in the State and published Bulletins 226 and 231 on this work. The peach orchards planted for experimental purposes at Vineland and High Bridge came into bearing during the year and some of the newer varieties fruited sufficiently to give indications of their value as commercial sorts. Studies were also continued on the behavior, prevalence, and control of peach diseases.

The investigations with carnations and roses were conducted for another year in greenhouses. The results with carnations upon the various soil mixtures indicated that the physical character of the soil is an important factor in the success of this plant. It was also observed that a certain variety of rose produced good crops of high-quality flowers during the past season on plats which had received only chemical fertilizers. Several demonstrations of greenhouse fumigation with potassium cyanid were made by members of the horticultural division in private ranges with entire success. Some cooperative fertilizer tests were planned and begun with one of the prominent rose growers of the State.

The work of the stations in animal husbandry included the maintenance and grading up of the dairy herd and some observations on growth and feeding of forage crops to cheapen the cost of milk production. The work in this line, as already mentioned, was strengthened by the organization of departments of dairy husbandry and poultry raising.

The biologist continued investigations on oyster propagation and floating and was able definitely to establish certain important points relating to the catch of spat on cultch. He demonstrated the marked advantage of placing shells as nearly as possible the day before the set occurs, and determined the conditions which make it possible to predict with reasonable certainty the date of setting as related to spawning. A comparison was made of planting shells in heaps and of sowing them broadcast in securing a catch of seed oysters. A new floating laboratory for oyster investigations was equipped and used for the first time during the year with very satisfactory results.

In cooperation with the horticulturist the entomologist carried on a study of the insect enemies of the peach, including particularly investigations with reference to the influence of the plum curculio in favoring the development of rot or causing a portion of the June drop, and a series of experiments on the control of the peach borer. Investigations were also made on the injuries and methods of control of the flea beetle on cranberries. In connection with his work

as State entomologist, he made a study of nursery insect pests and continued observations and study of insects injurious to shade trees. In continuation of a systematic test of insecticides, experiments were made with iron arsenate and nicotin extract. The work on mosquito control in progress for several years was continued.

In connection with the fertilizer inspection a study was made of the feasibility of using nitrate of soda in mixed fertilizers and the practical advantage of such use was clearly demonstrated. Considerable attention was given to the testing and perfecting of analytical methods. The stations continued cooperation with the State geological survey and with this department in a soil and agricultural survey of the State, the stations giving attention especially to the fertility of the various soil types.

The following publications were received from this station during the year: Bulletins 228, Structure of Tomato Skins; 231, The Second Season with the Peach Orchard; 232, Contribution to the Study of Bordeaux Injury on Peaches; 233, Analyses and Valuations of Commercial Fertilizers, and Analyses of Fertilizer Supplies, Home Mixtures, and Special Compounds; 234, Analyses and Valuations of Commercial Fertilizers and Ground Bone; 235, Insects Injurious to the Peach Trees in New Jersey; 236, Spraying Experiments with Peaches, and the Annual Report for 1909.

The income of the stations during the past fiscal year was as follows:

State Station: State appropriation (fiscal year ended Oct. 31, 1911) -----	\$47,000.00
<hr/>	
College Station:	
United States appropriation, Hatch Act-----	15,000.00
United States appropriation, Adams Act-----	14,558.78
Balance from United States appropriation, Adams fund-----	441.22
<hr/>	
Total-----	77,000.00

The work of the New Jersey stations is developing steadily, and increasing in scientific thoroughness and practical usefulness. It has a prominent place in the agricultural development of the State.

NEW MEXICO.

Agricultural Experiment Station of New Mexico, *State College*.

Department of New Mexico College of Agriculture and Mechanic Arts.

LUTHER FOSTER, M. S. A., *Director*.

Some lines of work at the New Mexico station were materially strengthened during the year, while progress on some experiments was retarded through numerous changes on the station staff.

Of the Adams fund projects, the investigations on cacti were about completed. The breeding and selection work with Mexican chili was continued, but some difficulty was experienced in attacks of a disease which killed or injured some of the original strains. In the work on crown gall of grapes about 100 varieties reached the stage at which it was proposed to dig them out to note the relative resistance of the varieties preliminary to further study of the disease and its transmission. The work on the failure of potatoes to produce tubers was continued on different soils and with different fertilizers in pots, field plats, and the greenhouse.

The irrigation project included studies of the movement and utilization of the water in the soil and of the effect on the water table by pumping from a varying number of wells at the same time. Some new equipment was provided for these studies.

A study of the nutritive effect of feeds for beef production was begun with 10 yearling and 2-year-old range steers in convenient stalls and yards built for the purpose. In this connection digestion experiments were conducted with two yearlings and two 2-year-old steers with a ration of alfalfa.

Investigations on the codling moth were actively carried on, and included, in addition to studies on life history and habits similar to those of previous years, observations on the effect of electric lights on the night movements of the larvæ.

Under the Hatch fund the work in agronomy included a test of duty of water for alfalfa, following the ordinary methods of irrigation practiced in the locality, but measuring the water and the crop, variety studies of wheat, oats, corn, barley, rye, and nonsaccharine sorghums, together with a comparative study of spring and winter wheats, and of variety work with alfalfa, including a test on the time of seeding. More than 20 varieties of wheat were under observation for the selection of pure strains for breeding purposes. Winter seeding was compared with spring seeding of wheat with results indicating that winter seeding may be preferable to the accepted method of spring seeding. Work was also carried on with short-staple and long-staple cotton. A series of experiments with potassium sulphate, acid phosphate, and manure on alfalfa was undertaken, as well as a test of fertilizers on a rotation with leguminous crops. A rotation of alfalfa, wheat, beans, and late corn was laid out, and tests were made of alfalfa as a nurse crop for wheat. A large number of non-saccharine sorghums were grown, and some high-yielding, quick-maturing strains were selected. Varieties of corn were studied with a view to selecting improved strains, and a number of miscellaneous tests with minor crops were carried on.

A number of important lines of work were followed in the horticultural department. A comparison of ditch and well water for

irrigating peach orchards was begun and studies were continued on the critical frost stage of the peach. It was shown that peach blossoms and fruit are generally more resistant to cold in the region of the station than in other parts of the United States. Tests of heading back and whitewashing peach trees for the prevention of sun scald were continued. The results of station experiments with peaches from 1906 to 1910 were published during the year in Bulletin 76. A number of varieties of apples most successfully grown in the north-western part of the United States were added to the new apple orchard. Various methods of irrigating and covering grapes to prevent winter injury were tested, with interesting results. The station vineyard contains a large number of varieties which have done well except for some winter injury. Experiments with cabbage included tests of varieties, time of planting, and fertilizers and manures. Onions were grown very successfully from home-grown seed and commanded as good a price as those from imported seed. Thinning was found, as in previous years, to be more expensive than transplanting. The results from experiments on the growing of Denia onion seed showed that a large quantity of good seed can be produced. Co-operation was carried on in orchard irrigation with this department and in celery and Denia onion experiments in cooperation with farmers of the State. Experiments were made with sweet potatoes both on the bottom and on the mesa lands. Apples were successfully budded on pear stocks. The phenological observations which this station has been making for several years were continued.

In addition to work connected with the Adams fund investigation of cacti, the chemical department continued a study of the irrigating waters of the State and also examined water samples to determine their fitness for domestic use. The cooperative investigation of the waters of several of the rivers was undertaken with the State engineer. Eighty-three soil samples were examined to determine their fitness for cropping and to suggest remedies for the removal of alkali. Analyses were also made of several samples of insecticides and two samples of sugar beets.

In animal husbandry a series of experiments was made with 20 yearling steers, testing alfalfa alone and with shelled corn, corn meal, and corn stover. It was found that local finishing can be profitably done with alfalfa alone. Some experiments were made in feeding grain to cows at pasture, also with alfalfa and grain for sheep. Summer experiments were carried on with pigs on alfalfa pasture supplemented with skim milk, corn, and barley. Experiments with pigs were in progress to test rations of alfalfa and skim milk; skim milk, shorts, and bran; shelled corn and alfalfa; and corn meal, skim milk, and alfalfa. In this connection a comparison was made of the



FIG. 1.—GROWING MELONS FOR CROSSING IN GREENHOUSE.

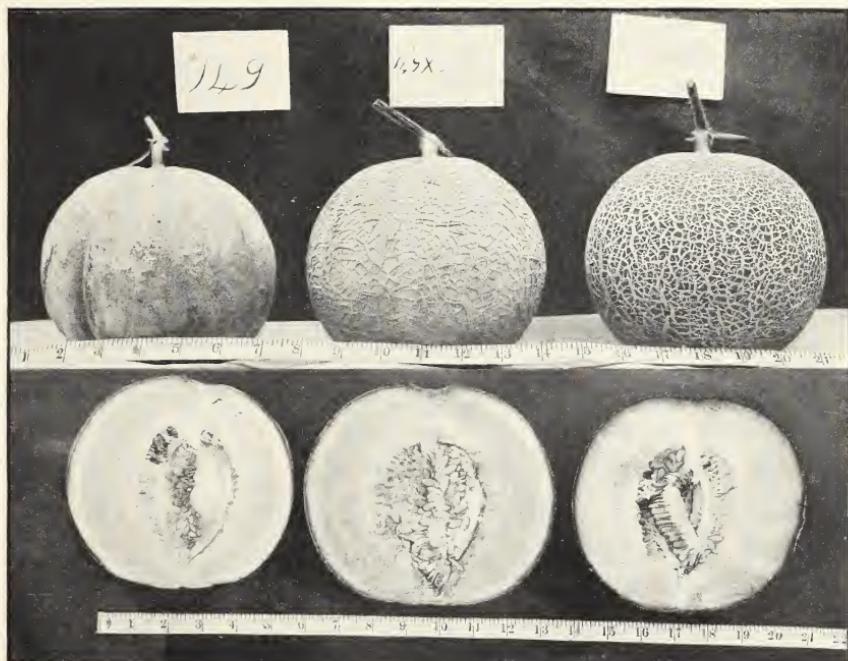


FIG. 2.—PARENTS AND OFFSPRING IN MELON CROSSES.

STUDIES OF INHERITANCE OF CHARACTERS IN MELONS, NEW HAMPSHIRE STATION.

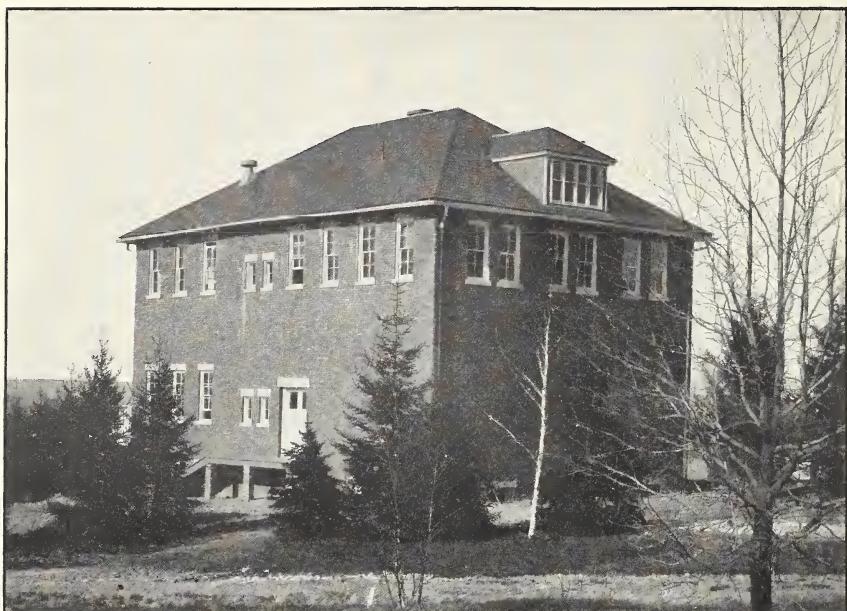


FIG. 1.—NUTRITION-EXPERIMENTS BUILDING, OHIO STATION.

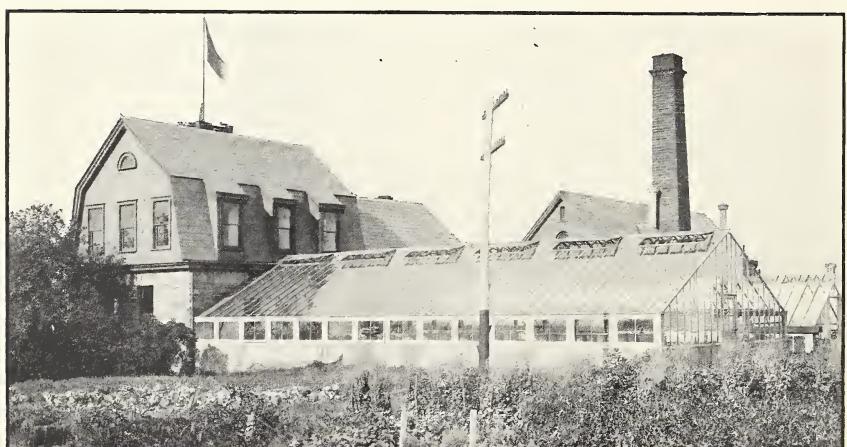


FIG. 2.—SOIL LABORATORY, OHIO STATION.

Tamworth and the Duroc-Jersey breeds. A poultry plant was started and a study of the causes of low hatch in incubators with eggs from six different breeds was made. Experiments in egg preservation were started and an incubator cellar was constructed. The work in dairy-ing was limited to some tests of covered milk pails and a comparison of soiling crops.

The principal investigation carried on by the department of meteorology was in cooperation with the department of soils and consisted of determining the air, water, and soil temperatures, relative humidity, wind velocity, and rainfall. The time of maximum temperatures of the surface soil was determined, and some relation between soil texture, soil temperature, and air temperature was established.

The publications received from this station during the year were as follows: Annual Reports for 1909 and 1910.

The income of the station for the fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act -----	15,000.00
Farm products-----	1,488.13
Fees-----	1,310.38
Balance from previous year-----	319.53
Total-----	33,118.04

The New Mexico station has to deal with varied agricultural problems, with only the comparatively limited Federal funds. Its efficiency could be greatly increased and the benefit to agriculture correspondingly enhanced by financial aid for supplementary lines of work which can not be undertaken with the funds from the Federal Government.

NEW YORK.

New York Agricultural Experiment Station, Geneva.

W. H. JORDAN, D. Sc., LL. D., *Director.*

Several important changes occurred on the staff of the station during the past year. A farm of about 90 acres, cornering on the station farm, was secured with a State appropriation of \$15,500, to furnish additional land for experimental purposes. The special appropriation for work on grape diseases in the Chautauqua district was discontinued, but the work was maintained with a balance of funds from previous appropriations.

The Adams fund work of the station was in continuation of the two projects heretofore approved, and was maintained in part by State funds with which the greater part of the station work is carried on. Progress was made on the project in animal nutrition with special reference to the physiological effect of certain phosphorus

compounds, but the work was not completed. The cheese investigations were conducted cooperatively by the chemical and the bacteriological departments of the station. The chemical study of the cheese-making process was well advanced and the part played by bacterial enzymes in this process was given much attention. Studies on the fermentation of citric acid in milk and its relation to cheese making were reported on during the year in Technical Bulletin 14. It was found that the citric acid amounting to about 0.2 per cent entirely disappeared during the cheese-making process, being converted into acetic acid and carbon dioxid.

Under other funds, mainly derived from the State, the station carried on numerous lines of work. The chemical department gave considerable attention to the study of milk and cheese not directly connected with the Adams fund project. In continuation of studies of the chemistry of lime-sulphur mixtures reported in Bulletin 329 of the station, investigations were begun in cooperation with the entomologist on the chemistry of mixtures of lime sulphur and lead arsenate. The development of a method for determining the purity of quicklime for spraying was undertaken. The method worked out for the preparation of lime-sulphur wash has enabled fruit growers to make their own preparations at reduced cost.

The work of the bacteriological department included the classification of soil and cheese organisms, a systematic study of cheese flora, and the determination of the germ content of milk from producer to consumer. An inquiry was made regarding the system of payment for milk on the basis of its sanitary quality, and a bulletin was published on this topic. The study of udder conditions as affecting the germ content of milk was completed during the year, and studies of the soft-rot organisms, which have been in progress for several years, were continued. Attention was also given to the bacterial count of milk as influenced by stable conditions, type of milking pail, and the condition of the milker.

The 10-year potato spraying experiments carried on by the botanical department were completed during the past season. These experiments have shown a pronounced profit from the systematic use of Bordeaux mixture and arsenicals as a result not only of protection from diseases and insect pests, but of stimulation of growth of the plants. Spraying with lime-sulphur mixtures did not prove so effective as the use of Bordeaux mixture. The main part of studies on currant-cane blight was completed and reported upon during the year in Technical Bulletin 18, but experiments on treatment of the disease were continued. Experiments in spraying with iron sulphate for the destruction of dandelions in lawns, which have been in progress for several years, have so far proven unsuccessful. Tests were made of

the corrosive sublimate treatment of cabbage seed for the prevention of black rot. This department also did considerable work in testing seeds, particularly alfalfa and clover seed, and studying various plant diseases to which attention was called from time to time.

The horticulturist continued work on the series of fruit monographs, which he has undertaken, and collected material for such monographs on peach, pear, and cherry. Plantations of many varieties of orchard and small fruits were maintained for study in this connection and for other purposes, such as the study of individual variations, breeding, and crossing. Improved varieties of apples developed by the station were distributed to some extent. Crosses of apples of the European and American types have been made with some promising results. Experiments in orchard culture and with fertilizers were continued, and extensive tests were made of the merits of budding apples from trees of known good quality. Tests of strains of Baldwin apples from 104 nurserymen were in progress. Experiments in crossing tomatoes were about completed, and variety and cultural tests with strawberries were reported upon during the year in Bulletin 336 and were continued.

The work of the entomologist was centered mainly on fruit insects, particularly those of the apple, pear, and grape as reported in Bulletin 331, and including the California thrips, the pear-tree psylla, the grape thrips, and Fidia. Attention was also given to the injury to pears due to a species of insect related to the tarnished plant bug. Tests of homemade concentrated lime-sulphur mixture and of screening as a protection against cabbage maggots were reported upon during the year in Bulletins 330 and 334, and studies of the life history of some cambium miners and of the apple and pear membracids were reported in Technical Bulletins 15 and 17. An effective method of controlling the pear psylla was worked out. Considerable field work on insecticides and other methods of control was in progress, the work on grape insects being done largely in the Chautauqua grape district.

The station conducted feeding experiments with poultry to ascertain the relative importance of certain mineral nutrients and carried on breeding experiments to determine the effect of selection and inbreeding on egg production.

The miscellaneous lines of work of the station included inspection of fertilizers, feeding stuffs, insecticides and fungicides, and dairy glassware, cooperative fertilizer experiments on potatoes, dairy herd tests and selection, and experiments on the effect of fertilizers on the yield and quality of tobacco in cooperation with this department. A large number of cooperative experiments, including experiments with alfalfa, in potato spraying, on currant cane blight, cabbage black rot, potato scab, leaf blister mite, Hessian fly, tarnished plant bug, grapes

and grape insects, orchard tillage versus sod mulch, dwarf apples, lime sulphur, potato fertilizers and varieties, and tobacco fertilizers were conducted in different parts of the State.

The publications received from this station during the year were as follows: Bulletins 323, Potato Spraying Experiments in 1909 (with popular edition); 324, Inspection of Feeding Stuffs; 325, Report of Analyses of Samples of Commercial Fertilizers Collected by the Commissioner of Agriculture During 1910; 326, The Modern Milk Pail (with popular edition); 327, Potato Fertilizers: Methods of Application and Form of Nitrogen (with popular edition); 328, Notes on New York Plant Diseases, I (with popular edition); 329, Chemical Investigation of Best Conditions for Making the Lime-sulphur Wash (with popular edition); 330, Experiments with Home-made Concentrated Lime-sulphur Mixtures (with popular edition); 331, A Preliminary Report on Grape Insects (with popular edition); 332, Director's Report for 1910; 333, Seed Tests Made at the Station During 1910 (with popular edition); 334, Observations on Screening Cabbage Seed Beds (with popular edition); 335, Spraying to Eradicate Dandelions from Lawns (with popular edition); 336, Newer Varieties of Strawberries and Cultural Directions (with popular edition); 337, Publicity and Payment Based on Quality as Factors in Improving a City Milk Supply (with popular edition); 338, Potato Spraying Experiments in 1910 (with popular edition); Technical Bulletins 13, The Constancy of Certain Physiological Characters in the Classification of Bacteria; 14, The Fermentation of Citric Acid in Milk; 15, Medullary Spots: A Contribution to the Life History of Some Cambium Miners; 16, The Acidity of Gluten Feeds; 17, The Apple and Pear Membracids; Circulars 11, Orchard Management; 12, Dwarf Apples; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$1,500.00
United States appropriation, Adams Act-----	1,500.00
State appropriation, including balance from previous	
year -----	112,575.85
Total -----	115,575.85

The New York State station has made steady and conservative progress in the several well-planned lines of research to which attention has been given, in most cases, for several years and has extended its work along logical lines of development. It has sought with marked success to make the results of its research work practically useful by extending them to different parts of the State.

Cornell University Agricultural Experiment Station, Ithaca.

Department of New York State College of Agriculture at Cornell University.

L. H. BAILEY, M. S., LL. D., *Director.*

Considerable progress was made at the Cornell station during the year in improvement of equipment and development of work. A number of changes in personnel occurred, and the pomological work of the station was organized as a separate department. The construction of the poultry building, for which the last legislature appropriated \$90,000, was begun, and a complete system of drainage of the experimental farm was undertaken. There was a large increase in the number of industrial fellowships established during the year, especially in plant pathology, in which there are now 12. The men holding these fellowships spend the winter months at the station doing laboratory work on special topics assigned to them, and in the spring go into the field to study the practical side of the question. In case of plant-disease studies quite complete temporary field laboratories have been established in a number of instances.

The Adams fund work of the station proceeded regularly. There was no material change in the general plan of the plant-breeding work, the most important feature of which continues to be the study and development of timothy. This work involved an elaborate study of the range of variation and of the biotypes of this grass. Some of the new types secured bid fair to be of great value for general cultivation. A test of 19 different new sorts gave an average increase per acre of 851 pounds over the best ordinary timothy obtainable. Experiments in potato breeding were continued as in previous years. Results of the last four years' work show marked variations in pure tuber lines and indicate striking possibilities in this line.

The study of methods of breeding oats, tests of value of hybridization versus selection in oat breeding, the cumulative action of selection, and the factors necessary to hardiness in winter-oat varieties were carried on. Experiments were also made on the cumulative action of selection in wheat. Other phases of the laws of inheritance in hybridization were studied with tomatoes, peppers, phlox, and other plants. Valuable results were accumulated, particularly with reference to inheritance of characters in tomatoes, peppers, and phlox. Certain phases of the relation of mutations and variations to breeding were studied with various plants, primarily with silene, corn, timothy, daisy, Stellaria, and many wild plants. Studies of the influence of environment in producing variations of importance in species and variety formation were continued with various cultivated and wild plants, particularly wheat and peas.

In studies in soil technology attention was given largely to loss of lime as nitrate in the drainage of the soil pits. It was found that the amount so lost was greater than that taken up by crops.

The entomologist completed a study of two species of red bugs of the apple and published the results in Bulletin 291 of the station. He further practically completed the work on the plum-leaf miner and jointworms of grasses.

With Hatch and other funds work was done in improvement by selection of brome grass, rape, vetch, and corn. Experiments in the improvement of wheat and oats were continued in cooperation with this department. Investigations were continued on the reciprocal relation of leguminous and nonleguminous plants to nitrification in the soil, confirming the results previously reported. Experiments with different systems of fertilizing in rotations were continued, together with studies of the effect of lime on nitrification.

Investigations on Mallophaga of fowls and work on the larch case bearer were completed, and the study of the life history and control of the apple-leaf roller was undertaken. Experiments were made on methods and cost of spraying for the elm-leaf miner, as well as on a parasite of this insect. Some work was also done on orchard protection by means of electric lights and charged wires on the codling moth in western New York, on the second brood of the apple maggot, and on onion thrips.

The new department of pomology made extensive plantations of orchard fruits to study stocks, scions, and varieties. Methods of packing and marketing received attention, and a survey of the small fruits of western New York was begun. Work on the classification of the peony was completed during the year and published in Bulletin 306, and similar work on sweet peas was nearly completed and that on gladiolus was continued. Experiments with fertilizers on muck soils with the object of reducing the cost of nitrogenous fertilizers were inaugurated.

In plant pathology attention was given particularly to investigations on black rot and other diseases of grapes, bean anthracnose, diseases of ginseng, lime sulphur, and other liquid and dust fungicides, apple-tree canker, diseases of peaches, fire blight, and other diseases of nursery stock, bulb rot and other diseases of gladiolus, chestnut-bark disease, and diseases of truck crops.

Investigations in plant physiology were conducted on respiration of fruits, respiration of seedlings, ripening and coloration of tomatoes under varying conditions of light, heat, and surrounding gases, morphology of the root-tuberle organism, production of active cultures of root-tuberle organisms, fermentation of tannin, antagonistic relation of mineral nutrients, yellows and other physiological

diseases, stimulation and toxicity, particularly with manganese and copper, and currant diseases.

Work in dairying included the modification of the Babcock test for cream and the relation of temperature to the accuracy of the readings in this test, efficiency of cream separators, studies of the city milk supply, the manufacture of Camembert cheese, moisture in Cheddar cheese, effect of starter on yield of cheese, metallic flavors in milk, tests of herds supplying milk to the dairy department, moisture in butter, and leucocytes in milk.

In animal husbandry, attention was given to the study of causes and prevention of losses in winter feeding of lambs, tests of feeding standards for dairy cows, skim-milk feeding of calves, tests of substitutes for oats for horses, breeding of heavier types of work horses, and production of hot-house lambs.

The work in the poultry department included breeding with a view to production of an American breed of white-egg producers, fattening with high and low protein rations, texture of rations for fattening poultry, and preservation of eggs in water glass, lime-water, and soap solutions. In cooperation with the chemical department a study was made of mineral matter in rations for hens, and in cooperation with the veterinary college investigations were conducted on bacillary white diarrhea.

As in previous years a large amount of demonstration and extension work was done under State funds and research men were not called upon to any great extent to take part in it.

The following publications were received from this station during the year: Bulletins 277, The Principles of Brooding—The Improved New York State Gasoline-heated Colony-house Brooding System; 278, Classification of the Peony; 279, Variation and Correlation in Timothy; 280, Pastures in New York; 281, Butter Moisture Tests; 282, Seven Methods of Feeding Young Chickens; 283, Control of Insect Pests and Plant Diseases; 284, Labor-saving Poultry Appliances; 285, The Cause of "Apoplexy" in Winter-fed Lambs; 286, The Snow-white Linden Moth; 287, Correlation of Characters in Corn; 288, Spray Injury Induced by Lime-sulphur Preparations; 289, Lime Sulphur as a Summer Spray; 290, Studies of the Fungicidal Value of Lime-sulphur Preparations; 291, The Apple Red Bugs; 292, Cauliflower and Brussels Sprouts on Long Island; 293, The Black Rot Disease of Grapes; 294, A Heretofore Unnoted Benefit from the Growth of Legumes; 295, An Agricultural Survey—Townships of Ithaca, Dryden, Danby, and Lansing, Tompkins County, New York; 296, Spraying for Black Rot of the Grape in a Dry Season; 298, The Packing of Apples in Boxes; 299, The Elimination of Tubercle Bacilli from Infected Cattle, and the Control of Bovine Tuberculosis and Infected Milk; Circulars 7, The

Relation of Lime to Soil Improvement; 8, The Elm-leaf Beetle; 9, Orange Hawkweed or Paint Brush; 10, Propagation of Starter for Butter Making and Cheese Making; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year, in addition to State funds, was as follows:

United States appropriation, Hatch Act-----	\$13,500
United States appropriation, Adams Act-----	13,500
Total-----	27,000

The work of the Cornell Experiment Station is well supported and is organized on a large scale. In response to public demand there has been a rapid growth of the more popular forms of work in different parts of the State, but this is quite distinctly differentiated from the more strictly research work of the station.

NORTH CAROLINA.

North Carolina Agricultural Experiment Station, West Raleigh.

Department of North Carolina College of Agriculture and Mechanic Arts.

C. B. WILLIAMS, M. S., *Director.*

The few changes occurring on the station staff during the year included the appointment of J. P. Pillsbury, of the Pennsylvania college and station, as horticulturist.

Satisfactory progress was made in the various Adams fund investigations. Some of the results in the studies on soil nitrification were published and further data were prepared for publication. A modification of the diphenylamin method for determining nitrates and nitrites was devised and the method thereby rendered far more delicate. The Tiemann-Schulze method for determining nitrogen was also modified to shorten the time necessary for its application and to remove a source of inaccuracy. The investigation conducted had a bearing largely on the efficiency of soil extracts, the inoculating power of soil extracts, and the value of nutrient media rather than soil extracts for the cultivation of soil organisms. Experiments were also begun to compare different methods of inducing nitrification in rich and poor soils. The work on soil nitrification also included studies on the movement of bacteria through the soil, associative activity of the soil organisms, and on nitrification in the greenhouse and in the field.

The study of lettuce diseases, especially the disease due to Sclerotinia, was practically completed during the year. Practical means by soil sterilization were worked out for the control of the disease. The results of this study were prepared for publication but some points regarding the cultural characters of the fungus remained to

be determined. The investigation of a disease attacking cabbage and other cruciferous plants was undertaken.

Work on the cabbage worm was held in abeyance because the pest did not make its appearance during the season. The melon-worm investigations were practically finished and the results were published in Bulletin 214, which deals with the pickle worm (*Diaphania nitidalis*) and the melon worm (*Diaphania hyalinata*). Work on the corn billbug was well started and studies on its life history were in progress. Hibernation records were made and the relation of *Sphegnophorus callosus* to other species was studied. The insect was found on species of Cyperus in one locality and a smaller species was observed on nut grass.

The veterinarian gave considerable time to the cottonseed meal project, performing post-mortem examinations of pigs, rabbits, and guinea pigs, and making clinical studies of the same. The animal pathologist cooperated in this project and made quantitative feedings of various extracts of cottonseed meal, the residue, and of pyro-phosphate of sodium to obtain material for further study. Results with rabbits and pigs appeared concordant, and death followed feeding the residue as well as the fresh cottonseed meal. The animal husbandman also cooperated in this work and carried on feeding experiments with cottonseed meal for hogs and worked much of the year with meal made from Sea Island cotton seed. Experiments were also begun with feeding cottonseed meal to sucking pigs to study the effect of early feeding. These feeding experiments were intended to supplement the laboratory investigations.

Studies on the relation of soils to productivity and their fertilizer requirements, and the cause of development of suckers and their effect on the yield of corn were continued. Data showing the effect of different fertilizers on the nitrifying power of soils and also on the humus, nitrogen, potash, and phosphoric acid in soils have now accumulated during six years. Among other facts, it was established that the presence of suckers did not decrease the yield of corn. The production of suckers was found to vary with varieties, fertility of soil, and distance of planting.

The horticultural department determined the cause of double flower and sterility in blackberries and dewberries, the results corroborating those of the Delaware station. A study of methods of control was in progress. In the study of self-sterility, all but three varieties of dewberries were found to be self-sterile, but when two varieties of self-sterile varieties were planted together they readily fertilized each other. Most varieties of blackberries also appeared self-sterile. The studies of the Rotundifolia grapes indicated that practically all the cultivated varieties are self-sterile. One vine was under observation to determine its possible self-fertility. Some of the results of this

work were published in Bulletin 209 of the station. A study was undertaken of the unit characters of Rotundifolia grapes, and about 2,400 seedlings were grown for observation.

The station pursued numerous lines of work with the Hatch fund. The agronomist tested 59 varieties of corn, 39 of cotton, 14 of wheat, 23 of oats, 26 of cowpeas, 21 of soy beans, 11 of adzuki beans, and 2 of seta beans. The results of the station tests with corn during the past few years have indicated that the relative standing of the different varieties is greatly modified by the fertility of the soil and the distance of planting. Promising results were secured with adzuki beans, the yield of seed per acre being better than cowpeas. Last year these beans required less than 100 days from planting to maturity.

In animal husbandry experiments were conducted to determine the value of cottonseed meal as a concentrate for horses, mules, and beef cattle, and the results secured in this work have largely been published. Other work of this department included experiments to determine the value of corn silage, corn stover, and cottonseed hulls as roughage for beef cattle, breeding experiments with swine, and a study of the value of different crops for pork production. Rye, oats, barley, and a mixture of these crops with rape, crimson clover, Canada field peas, soy beans, and cowpeas gave good results as grazing crops for hogs, and sweet potatoes, peanuts, and artichokes proved to be desirable root crops for this purpose. The poultry work at the station included the study of breeds and of systems of feeding and management. In dairy husbandry feeding experiments were conducted with cottonseed meal as a feed for heifers and young calves. A comparison was made of a mixture consisting of equal parts of corn meal, oats, and wheat bran, and of one made up of equal parts of cottonseed meal, oats, and wheat bran. The roughage used consisted of a mixture of corn silage and hay.

The animal pathologist pursued studies on fowl cholera, especially with reference to the effectiveness of vaccination against this disease.

In addition to the Adams fund work the entomologist conducted experiments to determine the breeding places of the common house fly and the effectiveness of different materials recommended for killing the larvæ in their breeding places. A 40 per cent solution of formalin in milk or in milk and water was used successfully in killing flies around dairy barns and dwelling houses.

Cooperative experiments with farmers in the mountain region of North Carolina were carried on to determine the suitability of sugar beets for that section both with reference to yield per acre and percentage of sugar developed in the beets. With this department cooperative experiments were made with tobacco to secure wilt-resistant strains. Other cooperative work with this department consisted of

studying different varieties of cowpeas, soy beans, adzuki beans, seta beans, barley, and tobacco, making a plant survey of North Carolina, and conducting tillage and rotation tests with cotton and corn. Co-operative variety and fertilizer tests with cotton and corn were conducted in different parts of the State on different types of soil.

The publications received from this station during the year were as follows: Bulletins 206, Insects and Fungus Diseases of Apple and Pear; 207, Hog Raising in North Carolina; 208, Fig Culture in North Carolina; 209, Self-sterility of the Scuppernong and Other Muscadine Grapes; 210, Improved Methods for Making Cottage and Neufchâtel Cheese; 211, Feeding and Management of Poultry for Egg Production; 212, Prevention of Oat and Wheat Smut; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act.....	\$15,000.00
United States appropriation, Adams Act.....	15,000.00
Farm products, including balance from previous year.....	6,377.94
Total.....	36,377.94

The affairs of the North Carolina station are in general in good condition, and its numerous lines of experimental work are making progress. Efforts are put forth to make all definite results immediately available to the farmer.

Agricultural Experiment Station of the North Carolina State Department of Agriculture, Raleigh.

B. W. KILGORE, M. S., *Director.*

The principal lines of work followed by this station during the year consisted of soil studies to determine the plant food or fertilizer requirements of the different types of soil of the State, the crops to which they are best adapted, and the methods best suited to their handling. In carrying out this work, systematic fertilizer tests were made on the different soil types, varieties of different staple crops were grown on them, and rotations for soil improvement were studied. Considerable time was given to the analysis of soils. Work was also carried on in different parts of the State with various horticultural crops, including apples, peaches, pears, strawberries, grapes, pecans, etc.

Considerable cooperative work was done with farmers for the purpose of popularizing results obtained by the station. In cooperation with this department the station made a special study of the Scuppernong grape, carried on tobacco work, and continued a soil survey of the State. The officers of this station give considerable attention to demonstration work and to farmers' institutes.

During the past year about \$70,000 derived from the finances of the State department of agriculture were available for experimental, demonstration, and farmers' institute work.

Bulletins presenting the work of the station were issued during the fiscal year ended June 30, 1911, on the following subjects: Analyses of Fertilizers and Cottonseed Meal, 1909-10—Registration of Fertilizers; Variety, Cultural, and Fertilizer Experiments with Cotton on Piedmont Red Clay Loam Soil; Variety, Cultural, and Fertilizer Experiments with Corn on Piedmont Red Clay Loam Soil; Variety Tests with Wheat and Oats; Inspection of Illuminating Oils; Annual Report of Farmers' Institutes; Estimates of Food Products Shipped Into North Carolina in 1909; Stock Feeds; Eleventh Annual Report on Food Adulteration Under the Pure-food Law; Analyses of Fertilizers, 1910—Registration of Fertilizers; Condimental Feeds, Stock, and Poultry Tonics and Conditioners; Variety Tests of Corn and Cotton; Report of General Work on the Buncombe and Transylvania Test Farms; Analyses of Fertilizers, 1911—Registration of Fertilizers (two bulletins); Experimental Work with Cotton, Corn, and Peas at the Iredell Test Farm; Preliminary Report on the Mountain Soils; and Cooperative Experiments and Demonstrations with Suggestions as to Soil Improvement, Cultivation of Corn, Cotton, and Legumes.

NORTH DAKOTA.

North Dakota Agricultural Experiment Station, Agricultural College.

Department of North Dakota Agricultural College.

J. H. WORST, LL. D., *Director.*

General progress was made in the various lines of work at the North Dakota station during the year. The station staff remained practically the same as the year before, and several of the station departments entered upon the use of the facilities afforded by new buildings recently completed. The new fire-proof chemical building, costing \$125,000, was occupied. This building is well equipped for research work, but the chemical library destroyed by the fire has thus far been replaced only in a small way. Additional quarters for the botanist were secured during the past year, and private parties provided funds for securing assistants in the pure-seed work of the department, its field-breeding experiments, and its studies on the histology and physiology of plant diseases. The State made biennial appropriations of \$25,000 for maintaining five substations, \$24,000 for the support of the demonstration farms, and \$15,550 for additional buildings and other equipment at the substations. For the enforcement of the pure-seed law, the State appropriates \$2,500 per year.

The Adams fund work of the station was conducted by the chemical, botanical, and veterinary departments. Work on the physiology of the sap movement in trees was continued, and as a check similar work was done with herbaceous plants, sunflowers, and corn, and studies on small trees and shrubs were begun in the laboratory and the greenhouse. The study of the principles underlying resistance and immunity to disease was continued as in previous years by breeding various cropping plants year after year under conditions believed favorable to the development of disease. The principal crops in this experiment were wheat, flax, and potatoes. The results of this research work have enabled the station to place in the hands of farmers three types of flaxseed highly resistant to disease. Two of the types are essentially wilt resistant and the other is both wilt and rust resistant. Similar work was done with wheat, and types developed under conditions testing their ability to resist disease have been originated and were distributed during the year for further testing their value in resisting disease. Cultures obtained in a study of soil organisms were tested under field conditions and their effect on crops was studied. Investigations on the bacterial and fungus flora of soils and their effect on the soil and plants were also continued during the year.

The results secured during the past year in the study of swamp fever in horses were embodied in Bulletin 94 of the station. It was found that the disease was due to a filterable virus, and further work was done on the problems of early and proper diagnosis. In this connection some of the more recent methods such as the complement fixation method and others were tried, and a comparative study was made of the disease known in Europe as anemia. It was found that the virus is present in the urine but apparently not in the feces of infected animals, and that infection can be induced through the mouth.

A continuation of the work on the nutrition of the wheat plant in its relation to soil conditions was reported. This work was mainly a study of the humus and other plant foods, and how they are changed by cultivation and cropping. Studies on the utilization of flax straw were in progress, attention being given to the chemical and other constituents of the fiber and the possibility of economically utilizing the straw in paper or other products. This study brought out an inquiry as to the presence of a glucosid of flax straw in various stages of growth and its relation to stock poisoning.

The study of the milling properties of wheat as affected by soils, varieties, and other factors was continued in cooperation with this department, and involved milling and baking tests of wheats and flours produced in different parts of the State as well as different varieties grown under varying conditions. Studies were made of

the nitrogen content of wheats and flours, especially the gluten, and also of the volume and quality of the loaf when produced from different flours; also the relation of phosphorus compounds to milling and baking, the effect of tempering grain on the quality of the flour, the relation of moisture to milling qualities, effect of frost, rust, bin heating, and other conditions.

The work in the department of agriculture was all supported by Hatch and State funds. The plant-breeding work of this department was considerably extended during the year, embracing work with alfalfa, wheat, oats, barley, flax, rye, corn, and potatoes. Nursery, centgener, and field trials were conducted to determine hardiness, yield, adaptability, quality, and other characters. Less variation was noted in the strains under investigation and a number of varieties were distributed for farm trial. Experiments on rotation and fertility were continued and laboratory studies on moisture, nitrogen, and other soil factors were in progress. The rotation plats were observed as beginning to show the benefits of previous cropping, and a study was inaugurated on a series of long rotations with and without live stock. Much of the agronomy work was carried on at the five substations and the 24 county demonstration farms, thus giving a wide range of conditions. Special studies in maintenance of soil fertility and methods of seeding crops to secure the best results, and of the cost of producing various farm products were in progress at the station and elsewhere.

In animal husbandry the economy of feeding for early maturity of pigs and the value and different methods of feeding peas, rape, barley, oats, and other feeds in comparison with dry-lot and grain feeding were studied. The question of cost of production was given considerable prominence. Wintering brood sows and sheep, cross-breeding sheep, and differences in wool production were given attention, and experiments with beef cattle to determine the value of corn when pastured off, the amount of stock various pastures will carry, and the cost of milk production under station and farm conditions were carried on. The station endeavored to interest farmers in better dairy stock and the assistant dairyman tested cows and had charge of the advanced registry of dairy cows in the State. The record of the station herd for five years was published in Bulletin 91. With poultry the principal line of work was breeding hens for high egg production, and studying methods of housing and feeding fowls. The records of the station showed a number of hens that produced 200 eggs per year.

The horticultural department used the new greenhouses in breeding work, especially pure-line breeding with lettuce and tomatoes. Selection experiments with sweet corn and muskmelons were begun with the intention to continue them as pure-line races. Similar work with

garden peas and tomatoes was carried on in the garden. The orchard work consisted of experiments with plums, apples, and other fruits, particular attention being given to the improvement of native plums in hardiness and vigor of growth. About 1 dozen plum selections and 200 apple trees were planted in the station orchard. With forest trees comparisons as to their drought resistance were made, and methods for the successful growing of coniferous seedlings under North Dakota conditions were demonstrated. Work was also done on the control of grasshoppers and cabbage worms during the past season, and studies on wireworms were undertaken.

The work carried on by the botanical department and supported by Hatch, State, and other funds included weed eradication, a study of oat varieties with a view to their standardization, plant breeding, selection of wheat and flax, seed inspection, testing of possible new crops such as Russian sunflower, hemp, and soy beans, cooperation with farmers in introducing disease-resistant varieties, and methods of cropping. In the State serum laboratory, with which the veterinarian is connected, studies were made regarding the action of various serums, their manufacture and use. The veterinarian also continued to render service to the State live stock sanitary board in the bacteriologic diagnoses of animal diseases.

A breeding circuit at New Salem, including about 200 cows owned by different farmers in that community, was conducted as a part of the cooperative work of the station. The 24 demonstration farms, located in as many counties and in counties containing no substations, give the station an opportunity to demonstrate the value of its experiments for practical results. The work on these farms has brought out very forcibly the value of crop rotation and the use of varieties adapted to the different regions. It has also shown that the soils of the State in general are short in their supply of phosphoric acid, while the supply of potash in nitrogen is apparently strong at the present time.

The following publications were received from this station during the year: Bulletins 88, Windbreaks and Hedges; 89, Wheat Investigations—Milling, Baking, and Chemical Tests; Special Food Bulletins 24-30; Paint Bulletins 4 and 5; the Annual Report for 1910; and the Annual Reports of the Dickinson Substation for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$14,447.72
United States appropriation, Adams Act-----	15,000.00
Balance from United States appropriation, Hatch fund-----	552.28
State appropriation, including balance from previous year -----	26,885.45
Miscellaneous, including balance from previous year-----	3,834.09
Total-----	60,719.54

The work of the North Dakota station includes a number of important lines of investigation of scientific interest and practical importance. Much field work was lost during the past year through the severe drought, but this also gave an additional test to some of the experiments in hand. The progress of the station would be materially aided by more direct support from the State.

OHIO.

Ohio Agricultural Experiment Station, Wooster.

C. E. THORNE, M. S. A., *Director.*

The changes on the staff of the Ohio station included a number of resignations and appointments in the corps of assistants and the appointment of J. W. Smith as climatologist. For the fiscal year 1912 the last general assembly appropriated the following amounts for the different station departments: Administration, \$35,500; agronomy, \$18,000; animal husbandry, \$20,000; botany, \$10,000; co-operation, \$30,000; entomology, \$8,000; forestry, \$12,000; soils, \$20,000; chemistry, \$5,000; horticulture, \$17,000; animal nutrition, \$8,000; and dairying, \$10,000, or a total of \$193,500.

A survey of the soil types of the State and studies on wool were begun during the year, and work with poultry and in soil bacteriology was undertaken. The nutrition building with equipment was completed at a cost of \$22,000. (Pl. VIII, fig. 1.) This is a two-story structure 40 by 60 feet in size, containing rooms for metabolism experiments with animals, slaughtering and curing rooms, machinery for handling and working up carcasses, and a 20-ton ice machine. Considerable time was also given to the fitting up of the new soils building and the greenhouses. (Pl. VIII, fig. 2.) At the southeastern test farm a sheep and storage barn 60 by 68 feet, with a wing 24 by 72 feet, was erected to facilitate the work in sheep husbandry. At this farm there was also erected a laying house 20 by 60 feet in size for extensions in poultry work. The facilities for poultry work were also somewhat enlarged at Wooster.

The Adams fund work was centered on three projects. The study of the relation of lime and phosphorus to the maintenance of soil fertility was continued at the station and at Strongsville. The phosphorus content of the soils of the State and the forms in which this element is present and the forms best adapted to different soils were studied, as well as the chemical composition of crops grown on differently treated plats.

The investigation on the increase in fixation of desirable properties in plants was continued with pure lines of different crops to ascertain whether heritable variations occur in pure lines of self-fertilized plants. Starting with single heads of wheat, a study was made of

the variation in size of the kernel and the possibility of permanently changing the size of the kernels by planting the small and large kernels from the same head.

In the project on the rôle of phosphoric acid and other mineral elements, the nutritive value of different phosphorus compounds when fed to swine was studied. The results obtained thus far have contributed materially to a knowledge of the subject, but further work is required, together with a greater refinement and elaboration of method than anyone has so far bestowed upon it. The methods for the estimation of inorganic phosphorus in vegetable and animal substances, published in Bulletin 215 of the station, have received wide recognition. Complete ash analyses of a considerable number of foods and feeding stuffs were made, together with a continued search for improved methods of chemical analysis. In connection with this investigation, a review of the literature of phosphorus metabolism has been undertaken.

Under Hatch and other funds the chemist studied the effect of the treatment of the different fertilizer plats on the composition of the crops and published Bulletin 222 relating to this work on wheat. Work in plant physiological chemistry included the study of the absorption of plant nutrients by cereals, on which a report was presented in Bulletin 221 of the station. A study was also made of the influence of the sulphur supply in the soil on the protein content of leguminous plants. Cooperative analyses were made for the departments of agronomy, animal husbandry, horticulture, and soil fertility.

In agronomy, cultural, plant breeding, and seed tests were conducted with alfalfa, and varietal, cultural, and breeding work with clover, corn, oats, and soy beans. Work with special forage crops included a variety test with peas, beans, and millets; tests of peas and oats at different rates of seeding, and tests of various leguminous plants, including special tests with hairy vetch seeded alone and with rye. A comparison was made of 10 prominent meadow grasses, of 20 different crops and crop combinations seeded in corn at the last cultivation, and of live stock and grain farming. Wheat experiments included one-tenth-acre plat tests of over 60 varieties and one-hundredth-acre plat tests of over 100 varieties in pure-line strains.

The department of animal husbandry continued the comparison of corn and oats as feeds for work horses, and conducted an experiment in fattening draft horses for market. Different proportions of grain and roughage and a ration of corn and clover hay with one of corn, cottonseed meal, and clover hay for beef production were compared. A number of supplements were used in different proportions with corn in dry-lot feeding of hogs and green feeds were compared with each other and with dry feeds. The production of wool and mutton

received more attention than in previous years and preparations were made for the establishment of a wool laboratory and scouring plant.

The work of the department of botany was continued during the past year as outlined in the previous report. It included the examination of seeds for purity and germination, the identification of weeds, with suggestions for weed control, an investigation of plant diseases and methods for their control, and plant-breeding work with tobacco and certain wheat hybrids. Some definite results secured in the weed-spraying work were published in Circular 102. This department also published Bulletins 228 and 229, both dealing with plant diseases. Attention was also given to the canker diseases affecting apple and pear trees and to diseases of forest and shade trees. Plant-breeding work on tobacco was continued in co-operation with this department.

The department of entomology supervised the spraying of 125 acres or more of bearing orchards and made observations on the cost of spraying, the increase in yield, and the improvement in quality. Observations were also made on the efficiency of different spraying materials and their adaptation to the different orchard fruits. The studies of this department further included mill insects, bark beetles, wheat jointworm, the Hessian fly, chinch bug, insects attacking the sugar beet, the sod webworm, and the woolly aphid. Some of the results of this work have already been made public.

The department of forestry, which has a special annual appropriation of \$19,400, worked on a forest survey of the State, cooperated with State institutions in the improvement of existing forests and the establishment of new plants, and continued to extend nursery plantings and the distribution of trees.

The department of horticulture gave attention chiefly to the solution of problems in apple culture. In the station orchards varieties were studied and work in spraying, thinning, and cultural methods was carried on at the same time. A closely planted apple orchard of early bearing sorts and an orchard of dwarf apples were set out. The work of this department in rejuvenation of old orchards was partly reported upon in Bulletins 217 and 224. Orchard heating was given attention and results determining the practicability of such work were secured. Plant breeding was carried on with vegetables, both in the greenhouse and in the garden, and the collections of ornamental trees, shrubs, and other plants on the station grounds were increased.

During the past year the department of nutrition published in Bulletin 222 the results of a study of the mineral nutrients in blue grass, showing that the differences in mineral nutrients were due to differences in the soils upon which the grasses were grown. It was

also found that the content of blue grass in mineral nutrients may be very greatly increased by the use of fertilizers.

The department of cooperation conducted extensive cooperative field experiments in farm management and farm practice studies, observations on the production of milk in farm dairies, and studies concerning the swine and poultry industries.

Two county experiment farms, established this year under a recent law, were placed in charge of the station. One of these farms, in Miami County, contains 123 acres and is located about 2 miles northwest of Troy, and the other, the Paulding County farm, containing 92 acres, lies $1\frac{1}{2}$ miles south of Paulding. General schemes of experimentation were proposed for these two county farms and approved by the county boards of agriculture.

The publications received from this station during the year were as follows: Bulletins 214, A Brief Handbook of the Diseases of Cultivated Plants in Ohio; 215, Methods for the Quantitative Estimation of Inorganic Phosphorus in Vegetable and Animal Substances; 216, Spraying Machinery; 217, Apple Culture in Ohio; 218, The Status of the Potato-growing Industry in Ohio—Seasonal Notes on Potatoes; 219, The Relative Durability of Post Timbers; 220, Twenty-ninth Annual Report, 1910; 221, The Composition of Wheat; 222, The Mineral Nutrients in Blue Grass; 223, Fourth Annual Report on Forest Conditions in Ohio; 224, The Rejuvenation of Orchards; 225, The Farm Grasses of Ohio; 226, The Wheat Jointworm; 228, Two Recent Important Cabbage Diseases of Ohio; Circulars 82, rev., Cooperative Forestry Work; 98, Minor Items of Farm Equipment; 101, Illustrative Exhibits at State and County Fairs; 102, Spraying to Kill Weeds—Some Useful Methods; 103, Autumn Meeting of the Ohio State Horticultural Society; 104, Plans and Summary Tables of the Experiments at the Central Farm, Wooster, on the Maintenance of Soil Fertility; 105, Floats; 106, Seeding Lawns and Permanent Pastures; 107, A Successful Alfalfa and Truck Farm in Southeastern Ohio; 108, Orchard Practice; 109, Orchard Spraying Suggestions for 1911; 110, Treatment of Artificial Tree Plantation; 111, The management of Clover in Corn-belt Rotations; and 112, Commercial Apple Orcharding in Ohio.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation	200,090.00
Farm products	10,892.51
Miscellaneous	14,879.67
Balance from previous year	145,496.85
Total	401,359.08

The Ohio station is conducting a great campaign in which demonstration and cooperation form a prominent part. It serves as a bureau of information for the farmers and agricultural interests of the State, and it is reaching and aiding the farmer in a very large and effective way.

OKLAHOMA.

Oklahoma Agricultural Experiment Station, Stillwater.

Department of Oklahoma Agricultural and Mechanical College.

J. A. WILSON, B. Agr., *Director.*

In addition to the new appointments made at the beginning of the year and mentioned in the previous report, C. K. Francis was appointed chemist and O. O. Churchill, agronomist, on the staff of the Oklahoma station during the year. Since the close of the fiscal year a number of other appointments were made. The building operations were mainly confined to the construction of a commodious and well-arranged greenhouse and a hog-cholera barn.

Good progress was made on the two Adams fund projects under the direction of the veterinarian. Two reports on the work on artificial impregnation, and dealing more particularly with the vitality of the germ, were prepared for publication during the year. In studying the effect of cottonseed meal and other highly nitrogenous feeds on breeding stock, experiments were conducted with six hogs. The station chemist cooperated to some extent with the veterinarian in these investigations.

The work on breeding drought-resistant corn was a failure, due to severity of drought both at Stillwater and Goodwell, where the outside work of the project was pursued. Better results were obtained with milo maize grown at Goodwell in the work of breeding drought-resistant sorghums. The chemist cooperated with the agronomist to the extent of making a study of the chemical composition of the drought-resistant crops, particularly Kafir corn.

The study of a fungus disease of San José scale was brought to a close after the efficiency of the disease in the mycelium stage under certain conditions in the field had been demonstrated. The spore stage of this fungus, it was found, does not develop as far north as Oklahoma.

The sheep-breeding project was continued, and lambs from Shropshire, Merino, and Dorset crosses were obtained during the past year. Careful records, including data as to character of animals and wool, were made. The new sheep barn and lots furnished ample and excellent facilities for this work.

Under the Hatch fund the horticulturist made some fruit and pecan plantings and compiled information regarding the culture of these crops in the State.

The agronomist carried forward the permanent plat work with various field crops which has been in progress at the station for a number of years and introduced a new series of rotation experiments. A good system of card records was kept of this work, which included variety tests of corn, Kafir corn, wheat, oats, and cotton, breeding cotton for yield and quality of fiber, breeding corn for yield, continuous culture versus three-year and five-year rotations, tests of winter oats, fertility requirements of alfalfa and plant food requirements of Oklahoma crops in general in cooperation with the chemist, and tests of fertilizers in a new six-year rotation of crops.

The animal husbandman made experiments with alfalfa, rape, and other forage plants, especially fall-grown crops with and without grain for hogs, but the work was interfered with by hog cholera.

The veterinarian continued the study of the relation of bacteria to flavor and keeping quality of dairy products. He further continued the manufacture of hog-cholera serum with a biennial State appropriation of \$7,500, of which \$3,000 was available for a hog-cholera plant. In connection with this work some studies were made on the attenuation of the serum by heat.

The entomologist made some preliminary observations on the prevalence and transmission of chinch-bug infection and of the life history and treatment of the melon louse, locust borer, and false chinch bug. He also undertook a study the past season of the alfalfa webworm and of food plants of bees. In connection with the work on the food plants of bees the development of improved strains of bees was attempted.

The publications received from this station during the year were as follows: Bulletins 89, *The Chemistry of the Kafir Corn Kernel*; 90, *A Study of Bermuda Grass*.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	14,639.05
Balance from United States appropriation, Adams fund	360.95
Miscellaneous	3,764.64
Total	33,764.64

The Oklahoma station has made progress in the reorganization of its work and its staff, following the extensive changes in personnel which occurred at the close of the previous year. It is hoped that its affairs will now run smoothly and without interruption.

OREGON.**Oregon Experiment Station, Corvallis.**

Department of Oregon State Agricultural College.

JAMES WITHYCOMBE, M. Agr., *Director.*

The number of changes occurring on the staff of the Oregon station during the past year, which were for the greater part enumerated in the previous report, included the resignation of C. E. Bradley, the chemist, who entered commercial work. The State legislature made the following appropriations for the biennium: General station work, \$20,000; investigation of crop and fruit pests and diseases and horticultural problems in the State, \$30,000; Eastern Oregon substation at Union, \$15,000; dry-farming substation at Moro, \$5,000; substation for horticultural and irrigation investigations at Hermiston, \$6,000; establishing and maintaining a new substation in southern Oregon, \$10,000; establishing and maintaining a dry-farming substation in the Harney Valley, \$6,000; a total of \$92,000 for the two years.

During the past year the Adams fund work of the station was more clearly differentiated than heretofore and was strengthened in a number of other ways. In connection with the work on soil leaching the tank experiments were continued with different types of soil from different parts of the State. Various fertilizers were studied as to their effect on leaching. Absorption tests were continued, samples of water from the Columbia and Willamette Rivers were analyzed, and pot experiments were conducted with wheat and vetch on clay-loam and red-hill soils, with special reference to the effects of lime and gypsum. The work on this project was completed and the results were prepared for publication.

The study of lupulin in hops was continued, including its distribution in different parts, stages of growth, and varieties of the plant. The effect of kiln drying and the use of different fertilizers on the composition of hops was also studied. Considerable study was devoted to the testing and improvement of methods of analysis of hops, especially the resins.

Practically all the field work in the project on the pollination of the apple and conditions affecting it was completed, and the data obtained related to sterility and fertility of varieties of apples and pears and the determination of mutual affinities. This work was conducted at Medford, Hood River, Freewater, Milton, and Corvallis. In this connection attention was also given to the cause of the striping or banding of fruits, such as occurs on the apple and the pear.

The study of the irrigation of fruit in the Rogue River Valley was continued in two orchards, the number of trees under observation in each being increased. The station is now ready to publish the results

of five years of work, which has dealt with the effect of water on the soil, the trees, and the fruit; the relation of water to color, size, and yield of fruits; and the formation of buds as related to the succeeding crop. The station chemists studied the composition of apples as compared with those grown in the Willamette Valley without irrigation.

Work on gummosis of the cherry was pursued by the department of botany and plant pathology which was established July 1, 1910. The project was written up as a thesis, dated June 1, 1911. A more complete description of the organism isolated considered to be the cause of the disease will be included in the final report.

In further study of apple-tree anthracnose, the perfect stage of the organism causing this trouble was found and the results of field work on means of combating the disease favored Bordeaux mixture as a fungicide.

In studying lime-sulphur spray an effort was made to determine the ingredients injuring the foliage and a method of preventing their injurious effect. The relative fungicidal and insecticidal value of each element or compound, as well as their effects upon the host plant, were studied. The work was pursued in the laboratory and greenhouses and in different orchards in the Hood River district.

A large amount of work was done on the incubation of hens' eggs during the past year and data on moisture, carbon dioxid, ventilation, and other factors as related to size, weight, and death rate of chicks were collected. The lime content and moisture content of the chicks as related to the lime and moisture content of the eggs were determined, and a study was made of the influence of oil from the hen on the hatching of chicks.

Numerous lines of work were carried on the past season with Hatch and other funds. The department of agronomy made variety tests of wheat, vetches, soy beans, corn, barley, oats, and other crops. Selections of *Vicia sativa* with reference to protein content were made and ear-to-row tests with corn were conducted. The irrigation work of the department was extended to cover 3 to 4 acres with a pumping plant. Kale, beets, potatoes, alfalfa, squash, beans, and rice were grown with different amounts of water applied at different times.

With the support of the State appropriation, the horticultural work was extended. The department continued its tests of varieties of strawberries and undertook breeding studies, 1,500 seedlings of known parentage being under observation. Work in cherry breeding was carried on to obtain a late-maturing strain of Royal Ann, the leading canning variety. With prunes a similar breeding experiment is followed to obtain early varieties, and a prune survey of the State was undertaken as a basis of study of problems relating to this crop.

The subject of frost control was studied in the Rogue River Valley, and a report prepared upon the work. Culture work with vegetables was conducted, partly in cooperation, including irrigation experiments.

In entomology work was done on several insects injurious to fruits, including the brown aphis of the apple. For the entomological work \$5,000 of the State appropriation is available for crop-pest studies.

In animal husbandry attention was principally given to the feeding of hogs. Experiments were conducted in which tankage versus barley and tankage, and barley versus skim milk and barley, were tested. The poultry work of the station included experiments in egg production, and an experiment on pasturing cockerels on wheat-stubble fields to utilize the waste grain.

The bacteriologist made studies of diphtheria in fowls, the relation of bacteria to chicken mortality, and bacterial studies of leguminous plants with a bearing on the inoculation of Oregon soils.

The principal line of work carried on at the Hermiston substation was on the irrigation of fruit, the main problem being to get organic matter into the soil cheaply, to increase the duty of water, and to keep the soil from shifting. At the Dry Farming station at Moro wheat and supplementary crops, especially legumes, were grown. The Union substation conducted experiments in hog raising, cereal breeding, and testing hardy varieties of vegetables. The Harney Valley substation was located at Burns and has an elevation of 4,100 feet. Dry-farming experiments, including variety tests, cultural methods, and other studies, were in progress. The substation at Tolo in Jackson County, near Medford, is to be devoted to fruit and poultry, the land having been donated for the purpose.

The publications received from this station during the year were as follows: Bulletin 109, A Preliminary Report on the Vegetable Growing Industry in Oregon; Circulars 7, Fire Blight of Pear and Apple; 9, Iron Cow Stall—Hoard-Schulmerich Stall; 10, Productive Qualities of Fowls; 11, Garden Management, I; 12, Three Species of Apple Plant Lice in Oregon; and 13, Orchard Spraying.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$13,524.82
United States appropriation, Adams Act	15,000.00
Balance from United States appropriation, Hatch fund	1,475.18
State appropriation, including balance from previous year	58,057.03
Farm products, including balance from previous year	8,151.75
Miscellaneous	4,000.00
Total	100,208.78

There was much improvement in the affairs of the Oregon station during the past year, and a much larger amount of experimental work was done than formerly. The generous appropriations from the State have been of great assistance, and show the interest and sympathy in the work of the station.

PENNSYLVANIA.

The Pennsylvania State College Agricultural Experiment Station, *State College.*

T. F. HUNT, D. Agr., D. Sc., *Director.*

The staff of the Pennsylvania station was strengthened during the year by the addition of a large number of assistants in different departments. Otherwise there were few changes of importance on the staff. The facilities for investigation were increased by the construction during the year of an open shed suitable for conducting experiments with a comparatively large number of steers, and by the renting of an additional farm, which made possible the construction of an open shed for milch cows. A series of six lots adapted to experimental work in fattening hogs was also provided on this farm. The construction of two ranges of greenhouses, each 30 by 100 feet, with a suitable head house, added to the facilities of the department of horticulture.

As in previous years, the Adams fund was used principally in three general lines of investigation, conducted by the Institute of Animal Nutrition, the department of experimental pomology, and the departments of experimental chemistry and agronomy. The studies of the effect of fertilizers, manures, and lime on the soil and crops in the long-term rotation plats were continued, partly in co-operation with this department, and certain parts of the work were completed. The results secured have been embodied in 24 papers, which have appeared for the most part in the last four annual reports of the station. Fertilizer experiments similar to those on the rotation plats have been laid out on permanent pasture and the different lines of investigation were extended to these plats.

The year's work on the animal metabolism project was mainly along the line of making improvements in accessory features of the respiration calorimeter and in working up the results of previous work.

The investigations on the causes affecting yield and quality of apples were extended to include 12 orchards, covering 91 acres in different parts of the State, besides the new 29-acre station orchard. The results thus far secured in these investigations indicated nitrogen to be the limiting factor in apple-orchard fertilization. Experi-

ments similar to those with apples were undertaken with peaches, the work being done in a private orchard of 6 acres leased for 10 years with privilege of renewal.

Some progress was made in general and preliminary work on two other projects based on the soils of the old rotation plats, and including a study of the bacterial flora of certain of the general fertilizer plats and a comparison of effects of certain calcium and magnesium compounds upon the activity of the principal organisms of nitrification.

Considerable work supported by Hatch and State funds was in progress. This included a continuation of tests of varieties, fertilizers, methods of culture, and of improvement of strains of cabbage, tomatoes, and asparagus. The experiments with asparagus have shown that the yield and quality can be greatly improved by careful grading of crowns at the time of transplanting. A large amount of work was done in developing improved strains of early and late cabbage. The work with tomatoes included strain and variety tests and production of pure-bred seed. Varieties of strawberries were tested on limestone soil.

In vegetable pathology attention was given to apple canker, collar rot, winter rot of greenhouse tomatoes, winter blight or spring disease of tomatoes, and to a continuation of a study of clover diseases.

In dairy husbandry an experiment was begun to compare the food requirements of milch cows in an open shed and when kept in the ordinary basement stable. Investigations were also made on the increase in bacterial content of market milk from producer to consumer, the increase of bacteria in aerated and nonaerated milk, buttermilk substitutes, and on methods of making Swiss cheese. This department has also undertaken a large cooperative demonstration to determine whether a system of farming, including dairying, may be introduced which will prove profitable under the conditions.

The work in animal husbandry included tests of outdoor and indoor feeding, comparison of roughage and concentrates for finishing cattle, feeding experiments with draft geldings mainly to test substitutes for the ordinary corn, oats, and hay ration, and to study the effects of feed on the conformation of horses. The department also undertook experiments with 10 colts to obtain data on the cost of producing draft horses. Large additions were made to the live stock, including hogs, sheep, and cattle, during the year. The poultry work included feeding for egg production, methods of feeding, and a study of factors affecting eggs held for hatching.

In agronomy, experiments were made in the improvement of wheat and barley and on methods of plowing and subsoiling, together with studies of various phases of the effect of fertilizers and crop rotations on soil fertility. Cooperation was carried on with this department

in a survey of the fruit soils of the State and of soil surveys in two counties.

Experiments in the improvement of tobacco and in testing Davis, Mexican, and Connecticut seed leaf hybrid tobaccos and varieties of cigar-filler tobaccos were continued by the chemist in Lancaster County, with a State appropriation, in cooperation with this department. The chemist also continued work on the limestone soils of the State, on the value of acidulated hair, hoof, and leather refuse as sources of nitrogen in mixed fertilizers, and on various miscellaneous inquiries.

In the forestry department work was continued on timber preservation and methods of tree planting and propagation. Much of this work was done in cooperation with this department and with private owners. Comparative tests of different kinds of shingles with and without preservatives were in progress.

The station cooperated with the division of farmers' institutes of the State department of agriculture, and exhibited certain lines of its work at 11 county fairs. Eighty cooperative tests in 26 counties were conducted during the year, chiefly by ex-students.

The publications received from this station during the year were as follows: Bulletins 101, Meadows and Pastures; 102, Methods of Fattening Steers; 103, The Lighting of Farm Houses; 104, The Respiration Calorimeter at the Institute of Animal Nutrition of the Pennsylvania State College; 105, Influence of Type and of Age upon the Utilization of Feed by Cattle; 106, The Apple in Pennsylvania—Varieties, Planting, and General Care; 107, Poultry Experiments and Management; 108, Variety Tests of Oats; 109, Some Soiling Crops for Pennsylvania; and the Annual Report for 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Balance from previous year, State appropriation-----	2,465.57
Fees -----	17,705.00
Farm products, including balance from previous year-----	15,277.65
 Total-----	 65,448.22

The Pennsylvania station has grown rapidly in recent years, and its activities have increased in variety and in scope. They now include most of the lines of work of greatest importance to the agriculture of the State, and are thus widening the interest and support of the farming population.

The Pennsylvania State College Institute of Animal Nutrition, State College.

H. P. ARMSBY, Ph. D., LL. D., *Director.*

The year's work of the institute was devoted mainly to putting results of previous investigations in shape for publication and in

making certain improvements in the accessory parts of the respiration calorimeter, including especially electric parts of a new combustion furnace and improvements in devices for sampling the air current and for measuring separately the heat and carbon dioxid produced while the animal is lying and standing in the respiration chamber.

During the year progress was made in bringing up the arrears of computation upon previous work. Discussion of the results of the experiments made in the years 1904-1907 was completed and the full report upon them was published as a supplement to the annual report of the experiment station for 1910-11, under the title of "Influence of Type and of Age upon the Utilization of Feed by Cattle," and also as Bulletin 128 of the Bureau of Animal Industry of this department. During the year bulletins were also prepared upon "The Nutritive Value of the Nonprotein in Feeding Stuffs" and upon "The Maintenance Requirements of Farm Animals," both including a full review of the literature, and published as Bulletins 139 and 143 of the Bureau of Animal Industry. Two papers were also prepared for the Second International Congress of Alimentary Hygiene and of the Rational Feeding of Man, at the request of the American committee, viz, "Influence of Type and of Age upon the Utilization of Feed by Cattle," containing a summary of the more important points of the full report upon the same subject, and "The Respiration Calorimeter at the Institute of Animal Nutrition of the Pennsylvania State College." These papers have also been published as Bulletins 104 and 105 of the experiment station. The cooperation with this department was continued during the year.

PORTO RICO.

Porto Rico Agricultural Experiment Station, Mayaguez.

Under the supervision of A. C. TRUE, Director, Office of Experiment Stations,
United States Department of Agriculture.

D. W. MAY, M. Agr., *Special Agent in Charge.*

The work of the Porto Rico station during the year was continued along the well-planned lines previously described. Only few changes were made in the personnel of the station staff. The coffee investigations carried on for nearly 10 years on the Carmelita plantation were brought to a close and the work was transferred nearer to the station. The low portions of the fields were drained with earthen tile made on the premises and a machine was purchased for the manufacture of cement tile to facilitate future work of this kind.

In the act of Congress making appropriations for the station for the fiscal year, special provisions were made for coffee investigations. A 95-acre coffee plantation was placed at the disposal of the station for experiments in renovating an old plantation and for studies on

coffee diseases, insect pests, coffee improvement, and other phases of the coffee industry. The introduction of the higher priced coffees was continued and some of the Jaya varieties came into bearing. Some 3-year-old trees bore at the rate of 800 pounds merchantable coffee per acre, while the average of the island is only about 200 pounds per acre. Experiments were in progress in transplanting coffee trees and studies were made on the vitality of coffee seeds, the most economical and effective means of improving the productivity of coffee plantations, diseases and insect pests, and other problems of a similar nature. Among the coffee diseases, a root disease, a leaf spot, and a spotting of the fruit received most attention. A number of minor coffee diseases, together with some of the fungus and other troubles of cacao, coconuts, and bananas were also investigated, and a bud rot of coconut trees found at various places on the island was studied to determine the causative organism. Other work of the pathologist included the study of citrus diseases, especially gummosis, and of the nodules on the roots of the royal palm to determine some facts regarding their origin and function.

The station was active in interesting the people of the island in apiculture not only for the production of honey but also for the greater fertilization of flowers in citrus orchards and coffee plantations brought about by the bee visitors. Further attention was given to the insects affecting citrus fruits, although less injury was reported than formerly. A number of pests of the mango was investigated with a view to controlling them, and studies were also made of the coffee ant, insect pests of guavas, and of mosquito breeding. The entomologist found that mosquitoes did not breed in the mangrove swamps near San Juan.

The horticultural work was considerably extended and the study of stocks, fertilizers, and cover crops for citrus fruits was continued. Attention was given to varieties of citrus fruits adapted to Porto Rico, and data were collected to determine the causes of their great variation in productivity, character of fruit, and other features. Experiments were conducted on the introduction and propagation of the better varieties of mangoes, and definite consideration was given to the question of shade and leguminous cover crops in pineapple culture. The station had 27 varieties of pineapples under observation, and carried on experiments on the fumigation of pineapple slips before planting for the destruction of mealy bugs. The banana plantation was moved to more suitable ground, and of a large number of varieties 25 were selected for further study.

Work was underway on the improvement of yams, yautias, sweet potatoes, pigeon peas, beans, and other commonly grown crops. The work with vegetables was continued to determine the cause of rapid

deterioration in quality. Some attention was given to ornamental trees and shrubs and hardwood and nut-bearing trees.

The chemical department made decided progress during the year, a large amount of analytical work was completed, and a number of important lines of investigation was continued. These included studies on soil disinfection, the availability of nitrogen, and phosphoric acid in the native bat guanos, the effect of strongly calcareous soils on the growth and composition of plants, the action of lime in inducing chlorosis of plants, and the effect of various ratios of lime and magnesia on the growth of plants. In the study of the cause of chlorosis of pineapples it was found that the trouble was brought about by too much carbonate of lime in the soil, 2 or more per cent of this substance proving detrimental.

The work in animal husbandry was considerably broadened and it now includes horse breeding to improve size and conformation, breeding for work oxen, breeding of dairy cattle as well as the introduction and breeding of hogs, sheep, and poultry. Investigations on the mineral nutrition of pigs indicated that calcium chlorid can profitably be used with rations deficient in lime. The work begun in dairying was confined to the more sanitary handling of milk. Some preliminary work in the production of forage crops was begun and a variety of sorghum introduced from Barbados gave heavy yields on dry hilly lands. Work in making and feeding silage was continued and apparently the production of good silage offers fewer obstacles than in a temperate climate.

The cooperative work with planters and orchardists was extended in many parts of the island and experiments on various types of soil, the effect of climatic conditions, and other factors were included. During the past year a number of planters spent several weeks at the station studying improved methods of agricultural practice.

An association of the sugar planters of the island established during the past year an experiment station to take up the study of the peculiar problems relative to the production and manufacture of sugar. This movement will relieve the Federal station of much work with this crop. Some cane breeding and a few cooperative studies begun some years ago will be continued, but otherwise investigations on this crop will be concluded.

The publications received from this station during the year were as follows: Bulletins 9 (Spanish edition), Sugar Cane in Porto Rico; and 10, Insects Injurious to Citrus Fruits and Methods for Combating Them.

The income of the station during the past fiscal year was as follows:

United States appropriation.....	\$28,000.00
Sales and other funds.....	2,382.81
Total.....	30,382.81

The trend of agriculture in Porto Rico is toward intensive culture and, as a result, the station is looked to for information along many lines. The increased correspondence, station visitors, requests for publications, etc., all indicate that the station is growing in the appreciation of the people of the island.

RHODE ISLAND.

Rhode Island Agricultural Experiment Station, Kingston.

Department of Rhode Island College of Agriculture and Mechanic Arts.

H. J. WHEELER, Ph. D., D. Sc., *Director.*

At the Rhode Island station no changes occurred in the heads of departments during the past year, but a number of changes took place in minor positions. Several donations were made to the station for the purpose of assisting in its work and of furthering the agricultural interests of the State.

Good progress was reported on the Adams fund projects, and some of the results heretofore obtained were presented in some of the recent station publications. In following the work on the losses of broiler chicks, feeding experiments were made in accordance with the original plan of the investigation, and on this phase of the study Bulletin 145 was issued during the year. The work included a comparison of protein concentrates, especially beef scrap and cotton seed, and in this connection slaughter tests and chemical examinations of the chickens were made. Studies were also made of egg infection and the influence of different kinds of litter in the brooders. All the eggs of a certain number of fowls were examined bacterially for a year, and in many cases young fowls regularly produced eggs without bacteria. The influence of artificial bacteremias upon egg infection was studied by inoculating fowls with pure cultures of organisms derived from eggs, dead embryos, and chicks.

The results of the study on the effect of given crops upon the crops which follow showed that buckwheat, cabbage, Swedish turnip, and mangel-wurzels were not good crops to precede onions. Oats as a crop preceding onions gave better results than rye, and redtop proved better than timothy, while millet was found quite satisfactory. Other facts were observed in this study of crop successions, and the attempt was made by experiments in pots and otherwise to ascertain the reason for some of these observed differences.

The work of the year on the blackhead of turkeys embraced a study of the morphology and biology of *Eimeria avium*. The rôle of the flagellated organisms in the production of blackhead was further studied and attention was given to securing proof of lung infection of young chicks by a green mold. A study was also made of the

effect of different litter upon the presence of white diarrhea among brooder chicks.

The analysis of flat turnips as a means of determining the lack of phosphoric acid in the soils upon which they were grown was continued at the station and in other sections of the State, the station being assisted in this work by the Rhode Island Experimental Union.

The influence of sodium salts upon the constituents of plants was studied as in previous years. Some of the more recent field results have been published and other detailed phases of the more scientific side of the investigation have been reported in several of the recent annual reports. Out of this work there was developed an investigation on the effect of the varying nitrogen content of seed potato tubers upon the crop yield. A special study was made the past season of the possible effect exerted by sodium salts upon the total sugar and reducing sugar in the mangel-wurzel.

A study of physical soil factors and various chemicals in their relation to the growth of vegetables and flowering plants under glass was continued in the greenhouse with roses and carnations. Different forms of phosphorus and potash, sphagnum moss, clover, stable manure, and other substances were used.

Field and pot experiments were conducted in studying the physiological effect of sodium salts and the relation of iron and other compounds to toxic conditions of certain soils. Some of these substances were used in different amounts on rye and barley in pot experiments, and special attention was given to a study of the soil solutions.

The study of laws governing the breeding of domestic birds included work with pigeons, with special reference to morphological and physiological characters, hybridization work, which resulted in one new pheasant fowl hybrid, the father being an English ring-neck and the mother a buff silky bantam, and an investigation of the cause of barring in the Plymouth Rock breed. Studies were also continued on the inheritance of the ability to lay large or small eggs.

The study of lime and magnesia requirements of plants included work upon six plats upon which ground limestone, ground magnesian limestone, slaked lime, and slaked magnesian lime were compared. Where these forms of lime were used before seeding there was in all cases a fine stand of timothy and clover with but very little redtop, but where the same complete fertilizer was used without lime the crop of 1911 was almost absolutely redtop of good size. These results were secured in the preliminary work, and other determinations remain to be made.

The year's work on fowl cholera involved a biological study of 11 organisms secured from cholera-like diseases in poultry. This work established a basis for immunological studies, which were undertaken

with reference to active immunity in rabbits. Part of the results of this work was published in Bulletins 144 and 146 of the station.

The lines of work carried on under the Hatch fund by the department of agronomy included a study of crop rotations to ascertain the most economical methods of fertilizing and cropping Rhode Island soils when but little stable manure is available. A study was made of 3, 4, 5, 6, and 7 year crop rotations in this connection and the efficiency of each in the improvement of the soil was observed. In addition to this work observations were made on a market-garden rotation, an experiment was conducted in continuous corn culture, and attention was given to problems in grass, alfalfa, and corn culture and the use of different phosphates. The results of the continuous corn-culture experiments indicated the value of sowing crimson clover at the last cultivation of corn as compared with the use of winter rye in this connection. The experiments in grass culture were continued mainly to determine the best top dressing for grass land when chemical fertilizers only are available. The availability and the residual effect of phosphoric acid applied in the forms of double phosphate, raw iron and aluminum phosphate, roasted iron and aluminum phosphate, floats, basic slag meal, fine-ground bone, acid phosphate, dissolved bone, and dissolved bone black were compared. In the selection and breeding of sweet corn further comparisons were made of the sweet corn which had been under selection for several years and of commercial strains of the same variety. Work on methods of planting corn consisted of planting 2, 3, 4, 5, and 6 corn kernels in the hill in comparison with the same number of kernels planted equidistant in drills. The use of fertilizers in the different rotations mentioned above was studied to ascertain the greatest possibilities of profit rather than the greatest possible crops. Successful tests of soil inoculation and of alfalfa seedlings are reported. Fertilizer experiments with grasses for lawn purposes showed that sheep fescues and Rhode Island bent grasses persist where acid fertilizers are used, but that Kentucky blue grass disappears under these conditions, while it remains the prominent grass when alkaline fertilizers are employed. Experiments in the artificial growing of the swamp blueberry were continued in cooperation with this department, and tests were made in spraying cucumbers and cantaloups with a view to controlling a bacterial disease attacking these plants.

The chemist made a study of the availability of the nitrogen in certain materials used for fertilizing purposes, of the phosphorus and potassium requirements of plants at different stages of growth, the influence of crops on each other when supplied with deficient and optimum amounts of nitrogen, nitrogen-gathering value of leguminous plants, the relative growth of different kinds of plants on a

soil when deficient in the three principal plant-food elements, and the availability of floats when mixed with cow dung at the time of planting, when mixed with it several months previously, and when used without dung. The chemist cooperated with the agronomist to the extent of analyzing the materials used in the conduct of the field experiments as well as certain of the crops.

The station cooperated with farmers in most of the townships of the State in the growing of alfalfa and with farmers in the southern part of the State in an effort to introduce asparagus culture and other crops suited to sandy lands. The extension work of the station was limited to a few lectures delivered under the auspices of the college extension department.

The publications received from this station during the year were as follows: Bulletins 140, Abstracts of Feeding Experiments—Analyses of Feeding Stuffs; 141, Blackhead in Turkeys—A Study of Avian Coccidiosis (with abstract number); 142, The Availability of Certain Unusual Nitrogenous Manures; 143, Nitrogen Content and Yield of Crops as Affected by Different Nitrogenous Manures; 144, Fowl Cholera and Methods of Combating It; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Miscellaneous -----	2,040.65
Balance from previous year-----	2,962.15
Total-----	35,002.80

The affairs of the Rhode Island station are generally in good condition and its lines of work, many of which are highly important from a scientific as well as a practical standpoint, are actively pursued.

SOUTH CAROLINA.

South Carolina Agricultural Experiment Station, *Clemson College.*

Department of Clemson Agricultural College.

J. N. HARPER, B. S., M. Agr., *Director.*

At the South Carolina station the work in animal husbandry, veterinary science, and entomology was reorganized during the past year. The station veterinarian resigned and several assistants were appointed on the staff during the year, otherwise the personnel remained the same as the year before. A new dairy building, costing about \$25,000, to be used by the college and station, was in course of construction, and land was acquired for a new dairy barn to cost about \$15,000. The new horticultural grounds are well laid out and

the plantings are beginning to make a good showing. The mailing list of the station now includes about 18,000 names of farmers of the State. The legislature authorized the location of two additional substations and provided funds for their maintenance.

The work during the year on the several Adams fund projects was generally progressive. The horticulturist continued the study of the *Rotundifolia* grapes, giving special attention to self-sterility and the possibility of determining bisexuality in some of the varieties. For the purposes of this work over 150 seedlings were set out in the few horticultural grounds, but much of the study was conducted with older vines on the college grounds.

Pot work on the relation between transpiration and the amount of nitrates in the soil was begun in the greenhouse and supplemented with field experiments. In connection with this project a study of the morphology of corn as influenced by depth of planting and by nitrate of soda was made. The past year was the fourth in which experiments were conducted to determine the effect of pollen from barren stalks on the yield of corn. It did not appear that the corn decreased in yield from year to year, but it seemed that the pollen from the barren stalks affected the position of the ear on the stalk. In the study of the relation of soil type to length of cotton fiber, the importance of seasonal influence was clearly brought out. In 1910 the longest, finest, and most uniform fiber came from clay soils which contained some fine silt. Incidental to this investigation it was found that big-boll types of cotton are best adapted to sandy soils in South Carolina.

The department of plant pathology devoted most of its time to the study of cotton anthracnose, giving special attention to a study of the means by which the fungus passes from crop to crop and from plant to plant during the season. Spores within the seed and adhering to the lint seemed to be the principal means of carrying the fungus from crop to crop. It is believed that by selection of clean seed in the field and by planting on clean land the disease can be eliminated in a single season. A special study of the detection of anthracnose in cotton seed was made, and the centrifuge method was adopted for the accurate determination of the amount of anthracnose on the outside of the seed. It was found that where the disease was in the seed it always appeared on the seedlings.

The chemist devoted much time to work on the cottonseed-meal poisoning project. He made ether, alcohol, and water extracts for use in feeding experiments, nearly 400 pounds of cottonseed meal being extracted. Differences in the phosphoric-acid content of seed grown at the coast substation, representing the lowlands, and of seed produced at the Clemson station, which represents the higher altitudes in the State, were observed. Of the cottonseed meal, the

extractives and the residue were fed to four lots of pigs without injury. A study was also made of the cause of the seeming partial insolubility of potash salts when mixed with basic slag, the object being to determine whether present methods of analysis are at fault or whether a chemical reaction takes place on mixing.

The entomological department continued work on the project relating to the strongyloid parasites of sheep and calves, making studies of the life history of the parasites and of a method to determine the presence of blood parasites to explain the action on the host. The species of hookworms in cattle and sheep were found to be different, and a new form in rabbits was determined. The study of the relation of temperature and moisture to insect activity was pursued with species that could be easily observed in all stages of development. Apparatus was devised for the purpose of determining with accuracy the value of both moisture and temperature as factors on insect activity. The biological study of the slender wire-worm (*Horistonotus curiatus*) was continued as a cooperative study, an insect field laboratory being established in the heart of the wire-worm territory, and a current report of progress was issued.

Most of the experiments carried on with the Hatch fund were continuations of those planned a few years ago. The department of agronomy studied the fertilizer requirements of upland soils of the State for the various staple crops when grown in a number of different rotations. Data have now accumulated covering a period of about six years. It was found that large applications of potash are not needed for the staple crops in the Piedmont section and that corn requires more potash than does cotton. The rotation experiments showed that cotton with a winter cover crop followed by corn with peas was as effective in building up the soil as a three or four year rotation. Cotton-breeding work was continued to develop a high-yielding big-boll variety and a high-yielding long-staple variety. This work also included selection for increasing yield, quality, and length of fiber, the size of boll, and the general vigor of the plant. About 50 of the standard varieties of cotton were grown for comparison. The breeding work with corn resulted in an increase of the uniformity of the ear and of the yield of grain. A good variety for ensilage was also developed. During the past year data accumulated showing that oats and wheat should be well fertilized in the fall and be only top-dressed with nitrate of soda in the spring. The results of five years' tests with various cover crops were in favor of rye and vetch. The best grasses for holding terraced banks were found to be Texas blue grass on northern exposures and Bermuda grass on southern exposures.

The horticulturist conducted experiments with asparagus which showed that the male plants produced 50 per cent more stalks than

the female plants and that they also appeared to be more rust resistant. A new variety of okra, developed by the department, was disseminated throughout the State. The horticultural work also included experiments with apples, peaches, and a great variety of vegetables.

The entomologist pursued considerable cooperative experimental field work which was in part supported by State funds. This work included studies of the cotton and corn-root louse (*Aphis maidis-radicis*), together with several undetermined species, the black-corn billbug (*Sphenophorus maidis*), another species of billbug (*S. callosus*), and two troublesome shade-tree insects, the cottony maple scale (*Pulvinaria innumerabilis*) and the gloomy scale (*Chrysomphalus tenebricosus*). Cooperative spraying experiments were carried on to determine the amount of spray material necessary and the cost of operation with various commercial lime-sulphur washes as winter sprays and with different brands of arsenate of lead as summer sprays. Some attention is also given to the purple scale (*Lepidosaphes beckii*), an insect attacking the fig in the State, and to an experiment for controlling crawfish in springs where they interfered with the successful use of the hydraulic ram.

The chemist obtained valuable data with regard to the use of different forms of nitrogenous manures and studied the influence of soil types on the formation of sugars, the work being done with sweet potatoes, and a preliminary report published in Bulletin 156 of the station. Sandy soils appeared to be associated with a higher sucrose content. Miscellaneous work of the chemist included a study of some of the sandy soils of the State.

At the Coast substation, near Summerville, the drainage of more than 100 acres was completed during the year and most of the tract was under cultivation, the principal crops being oats, corn, and cotton. Observations were also made on marling the soil at the rate of 1 ton per acre and on deep plowing. In addition to the staple crops mentioned some experimental work was begun to test other crops and to study distance and depth of planting, depth of plowing, the use of fertilizers, and other methods in connection with field-crop culture. Experiments with forage plants, vegetables, and other horticultural crops were inaugurated and many of the experiments at Clemson were duplicated at the Coast substation.

The publications received from this station during the year were as follows: Bulletins 151, Soils and Fertilizers; 152, Hog Cholera and the Serum Method of Treatment; 153, Notes on Varieties of Tomatoes; 154, Analyses of Commercial Fertilizers; 155, Corn and Cotton Wireworm; 156, The Formation of Sugars and Starch in the Sweet Potato; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	14,900.00
Balance from United States appropriation, Adams fund	100.00
Farm products, including balance from previous year--	7,146.07
Total -----	37,146.07

Conditions at the South Carolina station have materially improved and the work has been placed on a more efficient basis. The institution is making an earnest effort to meet the needs of the State, and appreciation of it continues to grow.

SOUTH DAKOTA.

South Dakota Agricultural Experiment Station, Brookings.

South Dakota State College of Agriculture and Mechanic Arts.

J. W. WILSON, M. S. A., *Director.*

The changes in the staff of the South Dakota station during the past year were practically confined to the department of agronomy. About the middle of the fiscal year C. Willis, agronomist, J. V. Bopp and W. L. Burlison, assistants in the department, resigned, and toward the close of the year A. N. Hume was appointed agronomist in charge. The improvements made at the station included the building of a number of silos to compare the relative efficiency, cost, and other factors of concrete, tile, and stave construction. The legislature authorized a new agricultural building, to cost \$100,000, and the State appropriations for the ensuing biennium included \$11,000 for substations, \$1,000 for seed testing, \$2,000 for alfalfa breeding work, \$2,000 for popular bulletins, and \$26,000 for farmers' institutes. A new substation was authorized in Fall River County for work on dry farming.

Progress was made on all Adams fund projects except one on which the work was interrupted by resignations in the department of agronomy. The investigation of the histology, bacteriology, and treatment of lumpy jaw in cattle was about completed at the end of the year. In this work the department of veterinary science was able to demonstrate a filamentous structure in Gram negative pus from the lesions. Cultural experiments and experimental injections with this pus were made, but this phase of the investigation was not finished.

The department of horticulture continued the improvement of hardy wild fruits by breeding and crossing, and some of the results were described in Bulletin 130 of the station. The most striking results were obtained by hybridizing the native plum with the Chinese apricot and the native sand cherry with the Japanese plum.

The past season these new hybrid fruits bore a heavy crop and many other new seedlings came into bearing. Good progress was also made in the breeding of hardy small fruits and apples. The practical object in view is to secure varieties of apples that will keep through the winter and be of perfect hardiness in tree. The data regarding the genetic principles deduced from these experiments were summarized and prepared for publication. A part of this work is conducted with the Hatch fund, while the expense of the scientific part of the experiment is charged to the Adams fund.

The projects in agronomy were followed as originally outlined. The study of the effect of rotations upon soil fertility included chemical analyses of soil samples for nitrogen, phosphorus, potassium, calcium, magnesium, iron, aluminum, sodium, and insoluble matter. In some instances definite plant-food materials were supplied and their effect upon crop yields compared. Work on the morphological characteristics of corn, wheat, and oats was begun this season. This included observations or morphological characters in relation to desirable and undesirable qualities, a morphological study of larger groups, and chemical work.

In the project on the digestibility of grains and fodders in studies of horses, the natural digestive coefficients under normal conditions were determined and completed and the results were prepared for publication. Work was begun on the second phase of this study, which relates to the digestive results obtained under some of the unscientific practice pursued not only under range conditions, but also under the conditions prevailing from time to time in the more favored sections of the State.

A part of the work on the effect of alkali water on dairy cows and dairy products was completed. The data relative to the effect of alkali water on dairy products were placed in manuscript form.

Under the Hatch fund the work of determining which crops and cropping systems are most suitable for permanent and profitable agriculture in South Dakota was continued, two systems of farming, grain farming and live-stock farming, being especially considered. Attention was given to the relative cost of conducting the two systems of farming, the relative profits which may be derived, the possibility of each of the two systems for soil maintenance, and the economic effect of pursuing either the one or the other. The results of studies relative to varieties and cultural methods of wheat, oats, barley, millet, corn, and grain sorghum were published during the year in Bulletin 124 of the station. Attention was also given to the alkali soils of the State. Bulletin 126 was published as a report upon a preliminary survey of alkali soils and as presenting methods for alleviating the ill effects of the alkali materials in such soils.

The work of the past year in animal husbandry included breeding western-bred ewes to pure-bred rams and feeding both parents and progeny on the same kind of a grain ration, feeding steers of different ages on the same kind of grain ration to determine the relation of age to gain, and developing a new breed of swine by crossing and selection to fix desirable characters. The results of the experiment on fattening steers of different ages were published in Bulletin 125 of the station. The results of experiments conducted with six of the leading breeds of sheep crossed with western ewes, extending over a period of six years, to determine the adaptability of the grades to South Dakota conditions, were presented in Bulletin 127. The breeds used for breeding purposes were Cotswold, Hampshire, Oxford, Southdown, Shropshire, and Rambouillet.

The major part of the botanical investigations concerned the life histories and general cytology of the rusts. In this connection, observations were made as to the possibility of grain rust being an internal parasite, thus being propagated by means of the seed. Some cultural studies were made on dry rot of potatoes which was prevalent during the year in the western part of the State.

The chemical department reported satisfactory work in its sugar-beet investigations. Attention was centered on the growing of pedigreed sugar-beet seed and a most satisfactory lot of mother beets was produced. About 4,000 analyses were made and a report on the progress of experiments in sugar-beet seed production, carried on in cooperation with this department, was made in Bulletin 129 of the station. Other lines of work with sugar beets included siloing in the field, commercial seed production, and spacing to secure maximum results. Cooperative work with this department on the morphological structure of the sugar beet as related to its sugar content was inaugurated.

The dairy department had in progress an experiment on the keeping of ice on the farm by different methods of storage. Experiments were also conducted on the cooperative efficiency and practicability of machine and hand milking. Feed and milk records of the dairy herd were kept and the results secured on the use of milk-powder starters in creameries were published in Bulletin 123 of the station.

The horticulturist studied the varieties in the station orchards, both top-worked and on their own stems, and continued the experiments in breeding hardy everblooming roses. During the past year several thousand blossoms were crossed with some of the best roses under cultivation, the principal work being done with the Siberian *Rosa rugosa* and the native wild roses. This department also continued its work in the introduction of hardy alfalfas. One-year-old alfalfa plants of four varieties—Omsk 1908 Siberia, Semipalatinsk Siberia,

Cherno, and Cossack were distributed, and observations on the seed production of individual plants were made.

The publications received from this station during the year were as follows: Bulletins 120, Progress in Variety Tests of Alfalfa; 121, Sugar Beets in South Dakota; 122, Creamery Butter; 123, Milk-powder Starters in Creameries; 124, Progress of Grain Investigations; 125, Fattening Steers of Different Ages; 126, Alkali Soils; Circular 1, Injurious Weeds Common in South Dakota; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation, including balance from previous year -----	9,985.28
Land endowment, including balance from previous year-----	2,089.89
Farm products, including balance from previous year-----	7,022.35
Total -----	49,097.52

The South Dakota station is pursuing substantial work for the agricultural interests of the State, and its sphere of influence is rapidly widening.

TENNESSEE.

Tennessee Agricultural Experiment Station, Knoxville.

Department of the University of Tennessee.

H. A. MORGAN, B. S. A., *Director.*

The Tennessee station, during the past year, constructed a barn providing room for work horses and for steers under experiment, and a 100-ton silo was built adjoining the structure. The work in bacteriology heretofore conducted as a branch of the department of botany was placed in a separate department. Few changes occurred on the station staff, the principal one being the appointment of C. A. Willson as animal husbandman. Progress in different lines was continued at the substation at Jackson, and cooperative work with farmers in middle Tennessee was begun and carried on according to a well-defined plan and under station supervision.

The Adams fund work of the station on humus formation and composition was continued, the effect of lime on humus being studied especially. The work was carried on with four different soils placed in cylinders with a cross section of one ten-thousandth of an acre, and in drainage cans with a cross section of one five-thousandth of an acre. Crops were grown under all of the various conditions and the drainage waters from the cans were weighed and analyzed. Studies were also made of the effect of different fertilizers on humus, the different soils, and on cropping.

Independent of the foregoing project, work was conducted on soil biology in its relation to humus formation. The improvement of the laboratory equipment for this work included the installation of a specially designed autoclave, consisting of a cylinder 28 inches in diameter and 36 inches long, connected with a steam boiler for the purpose of sterilizing soil. In addition, a complete equipment was secured for the determination of the various forms of nitrogen in the soil, and apparatus was designed for keeping the soil sterile while air and water are supplied freely, and for the cultivation of higher plants without the presence of bacteria. A special study was made of *Pseudomonas radicicola* of the soy bean in its relation to the transformation of the nitrogen in the soil and the bacterial content of soils and its capacity for nitrification, denitrification, and other activities were determined. Much of the work done on this project the past year was of a preliminary nature.

In the study of clover anthracnose, special attention was given to the physiology of disease resistance. During the past year about 200 acres of clover were grown in the State from immune seed and in every case the clover was free from anthracnose. The distribution of the disease-resistant strains was continued.

Studies on the life history and habits of the cattle tick were pursued as in the previous year, and the degrees of temperature and humidity limiting the tick area were determined. The time required for eggs to hatch and for seed ticks to die was worked out for three stations, Knoxville, Dallas, and Baton Rouge. This was found to be all a matter of cumulative effective temperature, and from the data obtained it is possible to establish the time limits of pasturing cattle without exposing them to tick infection.

The Hatch fund work of the station in agronomy included the development of a double system of cropping, a study of temperature and rainfall conditions with reference to crop production, experiments on subsoiling and deep plowing, a determination of the relative fertilizing values of ground phosphate rock and other phosphates, and a study of the lime requirements of Tennessee soils. Barley used in the double cropping system and fed to steers was found to be one of the best crops for building up the land. The value of deep culture became evident during the past dry year. Selection work with cereals was continued and the station now has its own strains of barley, oats, and tall oat grass. The results of experiments in a rotation of cowpeas and wheat and the utilization of various phosphates were published in Bulletin 90 of the station during the year. Rock phosphate gave about as good results where no lime was used on some soils, but on others inferior results were secured. Decidedly the best results were obtained from acid phosphate with lime.

The horticulturist pursued work on summer pruning of peach trees, selection of potatoes for increase in yield by means of bud variation as well as seed, and the culture of strawberries, together with the use of fertilizers for the crop. Experiments conducted for the control of peach blotch and peach rot emphasized the value of self-boiled lime sulphur as a fungicide.

The past year was the second in which operations were carried on at the West Tennessee station, at Jackson. Marked progress was made in bringing the station into good shape, and experimental work was followed with reference to cropping systems, deep tillage, feeding work, cooperative work with this department on cotton, variety and distance tests, the use of lime, and other cultural work. The feeding experiments were conducted with 100 steers and with feeds common to the western part of the State.

The publications received from this station during the year were as follows: Bulletin 89, Stand and Soil Fertility as Factors in the Testing of Varieties of Corn; and the Annual Reports for 1907, 1908, and 1909.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Farm products -----	7,323.64
Total -----	37,323.64

The Tennessee station is making good use of the funds and facilities at its disposal, is keenly alive to the agricultural needs of the State, and is meeting with success in its work.

TEXAS.

Texas Agricultural Experiment Station, *College Station*.

Department of the State Agricultural and Mechanical College of Texas.

B. YOUNGBLOOD, M. S., *Director*.

Changes in the organization and the staff of the Texas station during the past year included the discontinuance of the office of vice director and the appointment of a number of assistants. Shortly after the close of the fiscal year the death occurred of R. H. Pond, plant pathologist and physiologist of the station, and H. H. Harrington resigned as director, being succeeded by B. Youngblood, who took charge August 15, 1911.

The organization of the State substations was completed during the year and the following lines of work were entered upon: Irrigation and dry farming experiments at Pecos; grain and forage work at Lubbock; experiments with grain and cotton at Spur; experi-

mental work with grains at Denton; feeding experiments at Fort Worth; work with horticultural and field crops at Troup; rice experiments at Beaumont; experiments with rice, citrus fruits, and truck crops at Angleton; work with cotton and corn, citrus and other tropical fruits, and truck crops at Beeville; experiments with corn, oats, and cotton at Temple; and tobacco work in cooperation with this department at Nacogdoches. The cooperative forage substation at Chillicothe was discontinued. The State appropriated \$32,000 annually for the substations, including \$3,500 each for the older stations at Beeville and Troup. Land was bought at all of the substations, except at Fort Worth, where 280 acres of land was secured under a 6-year lease with privilege of renewal. The town of Fort Worth contributes \$1,000 per year toward the maintenance of the station.

Good progress was made the past season in the chemical projects under the Adams fund, especially the soil studies. Particular attention was given to soil potash, along lines similar to those followed with the phosphoric acid of soils, upon which reports have already been published. A bulletin on the studies of soil potash was prepared for publication. Work was also continued on active soil phosphoric acid in soils of high phosphoric-acid content, previous work being with soils of low content. The laboratory and pot work on active soil phosphoric acid and potash was extended to cooperative field experiments, 130 such experiments being in progress at the close of the year. A report on the results of 85 of these experiments, extending over three years, was prepared.

In continuation of investigations relating to humus, studies were made of the electrolysis of humus and of a method of determination. Electrolysis was studied with special reference to the removal of suspended clay from humus solution and to the precipitation of humus. Some of the results of this work have been published in three different station bulletins. The investigation on nitrification in relation to percolation in pots treated in various ways was continued.

In work relating to composition and digestibility of feeding stuffs, attention was concentrated upon a study of the composition of the ether extract and an investigation of the pentosans. In this connection 16 digestion experiments with sheep, fed on coarse feeding stuffs, were carried on, and the material so accumulated was studied. Considerable time was spent in devising methods suitable for the analysis of the ether extract of the particular feeding stuffs under investigation.

The equipment of the plant pathological and physiological laboratory in the station was increased and work was conducted on the relation of soil types to tubercle production by leguminous plants.

Studies were made with three typical Texas soils in pots and with extracts of these soils to determine the nitrogen-fixing power of *Pseudomonas radicicola* under different conditions.

The veterinarian continued work on swamp fever, giving attention mainly to the efficiency of various remedies and to the means and manner of transmission of the disease. A report on some of this work was published.¹

The horticultural work under the Adams fund was confined to breeding experiments with the blackberry, raspberry, and dewberry. Several thousand seedlings were secured to furnish parents for crosses, and about 100 dewberry-blackberry hybrids came into bearing during the year. A large number of dewberry-blackberry and blackberry-raspberry crosses were planted in open ground during the season. This work was partly carried on in cooperation with this department.

Among different lines of work conducted with the Hatch fund the chemical department of the station continued its systematic chemical study of the soils of the State as well as studies of soil acidity and fertilizer requirements. Examinations of alkali and waters were also continued. The inspection work of this department, which is separately provided for and so organized that it does not interfere with investigation, included the analysis of about 680 samples of fertilizers and over 1,000 samples of feeding stuffs.

The work of the department of agriculture included tests of various rotations with and without manure and fertilizers, tests of methods of planting corn, of bur clover as a winter cover crop, of peanuts as a forage crop for hogs, of cowpeas as an intercrop with corn, and of studies of the effect of feeding animals on the land and the effect of continuous corn and cotton culture, together with work in the improvement of corn by selection. The department of agriculture of the station has recently been superseded by the department of agronomy, with A. B. Connor in charge.

The horticulturist tested varieties of apples and conducted experiments with a view to overcoming injury to peach trees by nematodes, or crown gall. Tests were also made of a large number of grasses and forage plants to find a perennial pasture plant which will survive the hot, dry summers of the region. *Vitis champainii* was tested as a hardy stock for grapes.

The entomological department, among other activities, made experiments with a dry powdered arsenate of lead for the control of the boll weevil and the boll worm, but climatic conditions were somewhat unfavorable for this work. The head of the department, as State entomologist, had charge of eradication of foul brood of bees,

¹ Amer. Vet. Rev., 39 (1911), No. 2.

for which a State fund of \$1,500 was provided, and of crossing bees, for which there was a fund of \$500.

The animal husbandry work included feeding experiments with 80 yearling Shropshire sheep, in which eight different rations were compared and the effect of cottonseed meal was observed.

The veterinarian continued the study of Texas fever, testing the same remedies with this disease as with swamp fever. Hog-cholera serum was manufactured and distributed with State funds of \$500 per annum, a charge of 1½ cents per cubic centimeter being made.

The publications received from this station during the year were as follows: Bulletins 126, Active Phosphoric Acid and Its Relation to the Needs of the Soil for Phosphoric Acid in Pot Experiments; 127, Commercial Feeding Stuffs; 129, Studies of the Ammonia-soluble Organic Matter of the Soil; 130, Alkali Soils, Irrigation Waters; 131, Hog Feeding Experiments; 132, Report of the Co-operative Forage Crop Work by the United States Department of Agriculture and the Texas State Experiment Station at Chillicothe; 133, Commercial Fertilizers; 134, Report of the Director on the Establishment of the New State Stations; 135, Feeding Experiments with Steers and Hogs; and 136, Organic Phosphoric Acid of the Soil.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Miscellaneous, including balance from previous year-----	1,980.92
Total-----	31,980.92

The Texas station has great opportunities for usefulness to the agriculture of the State. Attention is being given to building up its work at the central station, and the State has provided for local experiments to meet the needs of various sections.

UTAH.

Agricultural Experiment Station, *Logan*.

Department of the Agricultural College of Utah.

E. D. BALL, Ph. D., *Director*.

There were comparatively few changes in personnel or lines of work at the Utah station during the year. A number of different experiments in horticulture, however, were inaugurated by L. D. Batchelor, who took charge of the horticultural department of the station in September, 1910. At the close of the fiscal year a number of important changes on the station staff went into effect. J. C. Hogenson, agronomist, was transferred to extension work and was succeeded by F. S. Harris; W. E. Carroll was appointed to take

charge of experimental work in animal husbandry; and C. N. Jensen was appointed botanist and pathologist, with the understanding that particular attention should be given to problems of plant physiology, such as change of function of plants under arid conditions and the physiology of beet blight. The veterinary investigations of the station were abandoned, but cooperation with this department on big head of sheep was continued. Additions were made during the year to the station live stock, particularly the Jersey and Holstein herds. Two of the former demonstration farms were discontinued, while two new ones were established, one near Cedar Fort station in Cedar Valley, where conditions are somewhat different from any that have so far been studied, and one near Ajax on shad-scale soil, to discover methods whereby such soil can be profitably handled under dry-farming practices.

The last legislature enacted a general statute providing a permanent yearly appropriation of \$15,000 for the maintenance of all substations and other outside work. The Indian school and farm at Panguitch was turned over to the station with a preliminary appropriation of \$2,500 to start experimental and demonstration work. The appropriation for extension work was increased and placed on a permanent annual basis of \$10,000, allowing the extension department to employ very largely its own staff of workers.

With Adams funds, investigations were carried on during the year on the conditions controlling the incubation of eggs and selecting and mating the fowls for egg production. A new incubator, securing satisfactory control of moisture, carbon dioxid, and temperature, was built during the year. The records of the breeding work were assembled, and two different important correlations seem to be established. The data on hand were prepared for bulletins on incubation work and several factors in the breeding problem.

Work on the alfalfa-leaf weevil, which continued to be the main line of investigation of the entomological department, was assisted by State funds. Studies of the life history of the insect and its distribution and control were continued. The results of experimental work with the pest were summarized and published as Bulletin 110 of the station. The methods recommended to reduce the injury caused by this insect include pasturing the fields with sheep, the use of gathering machines, brush-dragging the fields, and general clean culture. The results of a monographic study of the entire group to which the alfalfa weevil belongs was published.¹ Work on sugar-beet pests was limited to studies of the leaf hopper, with reference to its time of appearance, method of injury, and the effect of different cultural methods in lessening its devastation.

¹ Ann. Ent. Soc. America, 4 (1911), No. 4.

The study of the formation and movement of nitrates in irrigated and arid soils was extended during the year to rotation plats with manure, thus including the varying crop and fertility factors. The agronomist and the chemist of the station are working together on this project and in cooperation with this department. A partial report on this work has already appeared.

The station also conducted numerous experiments with the Hatch fund, and some of the more important work is here briefly mentioned. The chemical department continued a study of the chemistry and milling properties of different varieties of Utah-grown wheat, particularly as affected by the use of the combined harvester. Some of the results of this work, published in Bulletin 113, indicated that wheat cut with the combined harvester was just as valuable for flour-production and bread-making purposes as that cut with the ordinary binder or header. The superiority of Turkey Red wheat for bread-making purposes was also clearly brought out.

The department of animal husbandry tested barley, wheat, and oats as grain rations for fattening sheep. It was found, among other facts, that a ration of wheat with alfalfa gave very satisfactory results. Feeding experiments with pigs as well as studies of the cost of raising litters of pigs and of the maintenance of brood mares were continued. The results secured in different lines of work of this department were ready for publication. The poultryman continued experiments in the brooding, feeding, and housing of chicks and in various related lines.

The horticulturist started cooperative experiments in apple pruning and thinning, together with work in developing methods of management for securing the largest profits as well as permanency in orcharding. Experiments in irrigating peach orchards were undertaken in connection with other lines of irrigation work by the station.

The agronomy department experimented with different-sized cuttings, depth of planting, and irrigation of potatoes with sprouted and unsprouted tubers, and with rotations of potatoes with other crops. Selection of potatoes and selection and crossing of alfalfa were carried on, together with selection of sugar beets for seed yield and quality. Tests were made of varieties and methods of culture of beans, of varieties of oats and barley, and the culture of alfalfa.

The dry-farming work of the station, which is quite extensive, is maintained by State funds. The principal dry farm is located at Nephi, and the work there was mainly with wheat, barley, and oats, although tests with other crops, including alfalfa, field peas, and flax, were also in progress. Particular attention was given to testing varieties and methods of culture, to conserving moisture, and to plant

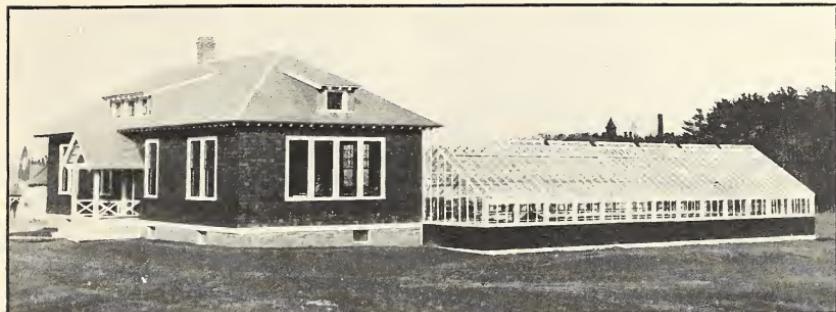


FIG. 1.—NEW GREENHOUSE, VERMONT STATION.



FIG. 2.—NEW HORTICULTURAL BUILDING, WISCONSIN STATION.

breeding for drought resistance. The results of seven years' work, covering a wide range of field and other crops under dry-farming methods in different parts of the State, were published during the year in Bulletin 112.

Irrigation investigations, mainly in cooperation with this office, continued to be one of the leading features of the station's activities, the larger portion of the work being supported by State appropriation. Testing the value of flood waters on sugar beets, grain, potatoes, and other crops was continued, and studies were made with reference to the best times of application and the amounts of water to use in the irrigation of potatoes and sugar beets. Attention was also given to irrigation as an important factor in the study of the milling qualities of wheat and of the study of the movement of nitric nitrogen in soils.

A drainage investigation, also in cooperation with this office and conducted under State funds, was continued, and the results of work in reclaiming seeped and alkali lands were published in Bulletin 111 of the station. In this work it was found that the ground-water level had been permanently lowered, and the leaching out of the harmful alkaline salts by means of rain and snow, as well as irrigation water, had been made possible. The large number of drainage projects in different parts of the State were under way, and a number of drainage surveys were made.

The publications received from this station during the year were as follows: Bulletins 109, The Nitrogen and Humus Problem in Dry-land Farming; 110, The Alfalfa Leaf-weevil; 111, The Reclamation of Seeped and Alkali Lands; 112, A Report of Seven Years' Investigation of Dry-farming Methods; and 113, The Influence of the Combined Harvester on the Value of the Wheat.

The income of the station for the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation -----	13,036.18
Farm products-----	4,240.60
Miscellaneous-----	520.72
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Total-----	47,797.50

The Utah station is prepared to extend and strengthen its work in several important lines. More liberal support has been secured from the State, its staff has been strengthened, and its problems of investigation more clearly defined.

VERMONT.

Vermont Agricultural Experiment Station, *Burlington*.

Department of University of Vermont and State Agricultural College.

J. L. HILLS, Sc. D., *Director*.

No important changes in the staff of the Vermont station took place during the year, but at its close R. M. Washburn, in charge of the dairy work, resigned, to take up similar work at the Minnesota station, and A. A. Borland, of the Pennsylvania station, was appointed to succeed him. In cooperation with the college the station increased and improved the greenhouse facilities for research and experimental work along a number of lines (Pl. IX, fig. 1). During the year all work of an extension character was transferred to the university, but remained under the direction of the director of the station. The State appropriations to the station were limited to \$1,000 for printing the annual report.

Practically all the lines of work conducted with the Adams fund the year before were continued. The study of the fundamental process relative to the storage of sucrose and other carbohydrates in the wood and in the bark of the maple was continued as outlined, particular attention being given to the form and quantity of carbohydrates stored each month in the year. A study was made of the anatomical structure of cells to determine where the starch is stored. The project was extended to include other species, among them being brown ash, oak, birch, beech, pine, and apple.

The study of forcing plants with carbon dioxid was pursued with lettuce, spinach, and radish in the greenhouse. Aerial applications of different strengths of the gas were tested, and its effect on forced plants was also studied. Microscopic and laboratory methods were applied to supplement the greenhouse trials. Sunshine and temperature were found to be important factors in this work.

The project on the effect of size of seed on the future plant was conducted with sweet peas, lettuce, spinach, radish, and beans, which responded to the selection of large seed, while other plants, among them pumpkin, summer squash, cabbage, and varieties of beans, varying but little in size and weight, gave indifferent results. An effort was made to establish the proper basis of seed selection.

The study of tolerance of forest trees was pursued in a forest nursery and in a piece of woodland where self-recording evapometers and other instruments were installed by means of which data were collected. Beds of seedlings were kept open in half shade and in full shade, and readings of the instruments were made at night in the woods and in the open. The work the past season was preparatory to a study mainly with reference to the amount of light and sunshine in relation to thinning.

The project on the microorganisms of maple sap and sirup was continued, and considerable work was done during the year on the fluorescent and pink organisms occurring in maple sap, including a green sap organism giving a dark sugar. The results of a study on the *Fusarium* causing the damping off of coniferous seedlings were published in Bulletin 157 of the station. The life history and habits of the fungus were studied and the most effective preventive measurements were determined. Sterilization of the soil by means of live steam did not give results warranting its general adoption, and the best preventive measure was apparently the disinfection of the soil by the use of a one-half to 1 per cent solution of formalin used at the rate of three-fourths gallon per square foot. It was found that after this treatment the bed should be allowed to air for at least a week before sowing the seed.

In pursuing the work on potato scab the cork layer in potatoes and its development was studied and the relation of the potato scab fungus to the soil organisms was investigated. No work was done the past year on the project on potato diseases, but the results already on hand were arranged for publication. The work on disease resistance of potatoes was continued but was interfered with to some extent by the nonappearance during the year of certain fungus diseases.

Work was also taken up the past year on the stimulating effect of Bordeaux mixture in plants, especially the potato and the effect of age and climatic condition upon the efficiency of Bordeaux mixture and other fungicides as shown by the inhibitory effect upon the germination of spores. These problems were made the basis of spraying experiments with potatoes. The effect of copper salts on the plants was studied and laboratory and greenhouse experiments were made on the physiological effects of such salts on the foliage. The fungicidal action of Bordeaux mixture also received considerable attention.

The study of the effect of feeding different amounts of digestible protein to cows for a long period, which has been in progress for several years, was carried on according to a comprehensive plan, and a large number of data were secured. About 60 cows, mostly Jerseys, but including some Holsteins, have been under experiment for the past 5 years. The attempt was made to make the protein the single variant of the ration fed.

Studies on the nutritive value of milk of different kinds were conducted with pigs. These experiments have also been in progress nearly five years, and over 150 young pigs, selected and arranged with great care and fed exactly, have entered into the experiment. Homogenized milk, condensed milk, and corn oil were used in the rations with varying results. The carcasses of the pigs were analyzed and the effects of the different foods were compared.

Numerous lines of work were conducted with the Hatch fund, the more important of which are here briefly enumerated. The chemist made a study of the alkaline and neutral permanganate methods as applied to vegetable and animal ammoniates, and the water-insoluble nitrogen containing residues in commercial fertilizers. The work was carried out in cooperation with the Rhode Island and Connecticut stations, and the method worked out at the station was adopted by all the New England stations. The veterinarian's work during the year was mainly in connection with the continuation of the study of infectious abortion in cows, and attention was also given to an outbreak of malignant necrotic stomatitis in swine and calves. The causal organism of this disease (*Bacillus necrophorus*) was isolated.

In the forestry work were included experiments in the thinning of white pine made in cooperation with agricultural students on land belonging to the university. The horticulturist continued work on scion selection to determine the value of scions selected from parents showing high productivity. Inheritance studies with cucumbers were conducted to observe the behavior of contrasting characters in the future plants. The offspring of the original crosses during the past year were in the third generation, and a strong, vigorous race of new forms has been secured, but further tests are necessary to determine the permanency of structural characters. The results of a study of plant diseases, occurring in 1910, as well as a compilation and coordination of the results of 20 years' work along similar lines, especially in relation to the weather, was issued as Bulletin 159 of the station.

The station performs practically no extension work, but has supervised periodic tests of pure-bred dairy cows.

The publications received from this station during the year were as follows: Bulletins 152, Commercial Feeding Stuffs—Principles and Practice of Stock Feeding; 153, Plant Diseases—Potato Spraying; 154, Commercial Fertilizers—Soil Classifications and Adaptations; 155, Principles and Practice of Ice Cream Making; Circulars 4, Forest Nursery Stock for Distribution in the Spring of 1910; 5, Concerning Bulletins 145, 147, 148, and 150; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
State appropriation-----	2,142.93
Individuals, including balance from previous year-----	220.20
Fees -----	2,795.48
Total-----	35,158.61

The Vermont station is making wise and effective use of its funds, and the general conduct of its affairs reflects much credit upon its management.

VIRGINIA.

Virginia Agricultural Experiment Station, Blacksburg.

Department of Virginia Agricultural and Mechanical College and Polytechnic Institute.

S. W. FLETCHER, Ph. D., *Director.*

The few changes on the staff of the Virginia station during the past year included the appointment of E. A. Back as station entomologist. For the years 1912 and 1913 the State appropriated \$10,000 annually, of which \$5,000 is for experiments with tobacco and crops grown in rotation with it and \$5,000 for district substations. The substations to be established with this fund, as well as the five tobacco stations already in operation, are in the nature of itinerant experiment plats rather than permanent substations. At each point from 5 to 25 acres of land are leased for a short term of years, and when satisfactory results have been secured the work is transferred to other sections of the State and to other problems. At the district substations one-half of the appropriation will be used for experiment orchards and one-half for experiments with field crops.

General progress was made in the Adams fund projects of the station during the year, and some of this work was completed. The study of the effects of care, feed, and environment on bovine tuberculosis was concluded after some work had been done with hogs to determine the liability of infection from feeding milk from tuberculous animals, the sweepings from their mangers, and through other means of exposure.

The study of fruit-bud formation was mainly along the line of working out methods. About 75 dwarf trees planted in cylinders have been provided for the study. The project on apple breeding was retarded to some extent during the year by a failure of the apple crop. For the purposes of this work, about 2,000 seedlings were on hand to be budded on dwarf stock.

In studying the fixation of phosphoric acid by soils, stress was laid on the form in which the phosphoric acid not used by the crop of one season remains in the soil, and on the effect of the fixation of this element by iron and aluminum hydroxid. The problem was also studied in a series of plats to correlate the plant growth with the amount of soluble salts. From field plat work in this connection, a large amount of material was obtained for analysis, and nitrate determinations were made on all soil samples.

The grazing project was continued in cooperation with this department. Analyses or estimates of the plats under different treatment

were made, and experiments were pursued in the improvement of blue grass by selection. Studies were also conducted on the effect of growing white clover with blue grass and of beans with corn, in relation to the nitrogen content.

In studying the relation of parasitic fungi and bacteria to their host plants, work was continued to determine the toxic agents causing decay. Work was also followed on the action of enzymes, the influence of the presence and absence of oxidase and peroxidase, the assimilation of carbon dioxid of diseased leaves, and the physiological action of the parasitic organism on the foliage.

A number of other lines of work were carried on in addition to the Adams fund investigations. The horticulturist began an experiment on the relation of nitrogenous fertilizers to pear blight, about 150 trees, some grown in sod and others in clean culture, being under observation. Hybridization work with cabbage was conducted in the greenhouse to study the transmission of the qualities and the manner of inheritance and the origination of new types. A new orchard of apples and peaches, set out to furnish material for the fertilizer experiment in orchard management, is designed primarily for experimental work.

The veterinarian continued experiments on the comparative value of different forage crops for hogs in different sections of the State, studied prevalent cattle diseases, together with the control of stomach worms in sheep, tested the use of the silo in wintering cattle, and made observations in breeding experiments with poultry on color transmission as related to Mendel's law. The dairyman worked largely on city milk control in cooperation with city authorities. He scored dairies and took samples for bacteriological analysis from 54. Some of the data secured were prepared for publication. A feeding experiment was made comparing broom sedge and pea-vine hay with mixed hay.

The chemist continued the study of the sugar content of French cider apples, and studied the composition of short clippings of blue-grass pastures.

In agronomy, acclimatization work with corn was pursued and experiments were made with two strains of corn to determine the possible influence of mixing on the yield. Work on the improvement of wheat, cowpeas, soy beans, and other field crops by selection was carried on and the permanent rotation and fertilizer plats were continued.

The plant pathologist studied tomato rot and tomato spot, together with the cause of frog-eye spot on leaves of spinach. About 25 hybrid varieties of tomatoes were tested for disease resistance. The results of a study of club root of cabbage were published in Bulletin 191 of the station. The results of experiments showed that

the use of lime was distinctly beneficial in combating club-root disease in the field, and that the after effect of lime as shown on a plat where it was applied two years previous to the experiments was quite marked. At the expense of the Crop Pest Commission, he pursued work on peach yellows, having about 700 diseased trees under observation.

The publications received from this station during the year were as follows: Bulletins 186, The Efficiency of Hand Separators; 189, Some Diseases of Swine; 190, Cooperative Herd Testing; 192, Tomato Blight and Rot in Virginia; and Circular 8, The Dairy Cow and Her Record.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$13,789.01
United States appropriation, Adams Act-----	14,960.00
Balance from United States appropriation, Hatch fund-----	1,210.99
Balance from United States appropriation, Adams fund-----	40.00
State appropriation, including balance from previous year -----	6,930.49
Farm products-----	5,561.33
Miscellaneous, including balance from previous year-----	193.50
Total-----	42,685.32

The Virginia station is doing a large amount of work and is striving to make itself of the greatest usefulness to the agriculture of the State. The relations of the station with other agricultural agencies of the State are favorable to agricultural progress. The Federal funds are now inadequate to develop the fullest efficiency of the institution and other support is much needed.

Virginia Truck Experiment Station, Norfolk.

Cooperating with the Virginia Agricultural Experiment Station and the United States Department of Agriculture.

T. C. JOHNSON, B. S. A., M. A., *Director.*

At the Virginia Truck Station, a new greenhouse was erected at a cost of \$2,320.75, and a Skinner irrigation system covering about 4 acres was installed at a cost of \$831.71. There were no changes in the station staff during the past year.

The station continued its work on the control of insects injurious to truck crops, giving special attention to the spinach aphis (*Myzus persicae*), and the control of insects affecting cabbage during the cooler months. Observations on the influence of certain commercial fertilizers on truck soils and truck crops were continued and a rotation including peanuts, potatoes, and corn, together with crimson clover and cowpeas was begun. The improvement of certain strains of cabbage and spinach was continued and investigations to deter-

mine the cause of certain sweet-potato diseases were inaugurated in cooperation with this department. In addition to this work, investigations on the fungus diseases of spinach in cooperation with the Virginia station, malnutrition work on spinach and other truck crops, and experiments to control certain diseases of seed potatoes were continued.

Spraying experiments were conducted with potatoes and the results showed that thorough spraying with Bordeaux mixture during the growing season improved the crop and its shipping qualities. Experiments on spraying cucumbers and cantaloups showed that certain fungus diseases may be held in check by the use of Bordeaux mixture and other sprays, but that the use of lime-sulphur solutions is not advisable. Cooperative work on spraying vegetables was carried on in several localities of the trucking region.

The publications received from this station during the year were as follows: Bulletins 4, Spinach Troubles at Norfolk and the Improvement of Trucking Soils; and 5, Spraying Cucumbers and Cantaloups.

The income of the station during the past fiscal year was as follows:

State appropriation	\$5,000.00
State Board of Agriculture and Immigration	5,000.00
Farm produce	2,035.32
Southern Produce Co.	254.19
Total	12,289.51

By means of its cooperative work and the pursuit of experiments along many practical lines, the Virginia Truck Station is performing a valuable service to the trucking interests of the State.

WASHINGTON.

Washington Agricultural Experiment Station, Pullman.

Department of the State College of Washington.

R. W. THATCHER, B. S., M. A., *Director.*

The changes in the staff of the Washington station were comparatively few in number during the past year and were mostly confined to the minor positions. W. H. Lawrence resigned his position as superintendent of the Puyallup station and as station plant pathologist on March 1, 1911.

The greater part of the experimental work of the several station departments was in connection with the study of the Adams fund projects approved for the institution. The project on the improvement in cereals was actively pursued and the amount of material for investigation was largely increased. A considerable amount of breeding work was in progress, the particular phases of investiga-

tion being on the possibility of getting a high-nitrogen grain by selecting high-nitrogen plants, the effect of germination on the chemical and physical make-up of gluten, the influence of soluble salts in flour on the gluten and the baking quality, and on the factors determining size and shape of the loaf of bread. Analyses and milling tests of the wheat kernel during progressive stages of its development were made and flour from partially developed heads and also from germinated wheat was studied with reference to its bread-making properties. The results thus far obtained showed that gluten did not play as important a rôle in the baking quality of flour as generally supposed, and this fact led to a careful study of the effect on the baking quality of the flour of the constituents other than gluten. A 5-year study of the chemical composition and milling quality of Washington wheats was completed and a final report issued as Bulletin 100. The selection of high and low nitrogen plants of each of four varieties of wheat was continued for the fifth year with negative results for this kind of selection work.

The soil-moisture investigations were continued and a study was made of the distribution of water through the soil under the conditions of natural rainfall and under irrigation, the amount of soil moisture lost by evaporation under different systems of tillage, the amount of water required for the most successful growth of crops, and the period of plant growth at which a sufficient water supply is most critical, and the development of roots and stems of various kinds of plants under limited, sufficient, and surplus supplies of soil moisture. Work was in progress to determine the amount of water required under field conditions to produce a pound of wheat, barley, oats, rye, emmer, orchard grass, millet, corn, sorghum, soy beans, field beans, potatoes, tomatoes, sugar beets, cabbage, carrots, and onions. Pot experiments in the greenhouse were made to determine whether plants are injured by lack of moisture before the wilting point is reached, at what period in the life of the plant drought is most serious, and the relation of the concentration of soil solution to the amount of water required to produce a pound of dry matter.

The department of botany studied tomato blight and isolated a fungus apparently the cause of the disease. The fungus was grown in pure cultures and cross inoculations on healthy plants were begun to determine definitely the relation of this fungus to the malady. The study of the toxic excreta of roots of conifer trees was still in the preliminary stages of an investigation of the proper control of culture solutions. In the study of the rots of the potato tuber four distinct diseases have been recognized, and laboratory work to isolate and identify the causative fungi was instituted. Work was also begun on the project on the progressive development of the wheat kernel.

The investigation on the function of sulphur as a plant food during the past year included greenhouse and laboratory work for the purpose of determining what plants or classes of plants will grow and mature in a soil medium containing all the necessary plant foods except sulphur; the possibility of eliminating sulphur from plant tissues by growing the crop successively on a sulphur-free soil; the relation of varying amounts of sulphur fed to plants to their normal composition; the depletion of the supply of available sulphur in a naturally fertile soil by successive heavy cropping with plants having a high sulphur content; the sulphur-nitrogen-phosphorus ratio in plants throughout different stages of growth and its uniformity from the same type of crop; and the accuracy of present methods of analysis for the purpose of quantitative investigations.

The study of bud weevils soon after its inauguration showed a whole series of unsuspected insects destroying buds of fruit trees. Material for the rearing of these insects and studying their life histories was collected and the insects were reared for study. Satisfactory progress was made on the study of the ground squirrel in a series of specially prepared pens in which several families of each of three species were reared for the purpose of securing accurate data as to their life history.

In the work on the Mendelism of hybrids of blackberries and raspberries two field plantings of these hybrids were made for the purpose of studying leaf characters, procumbent habits, and the relation of fruiting to leaf character. Progress was also made in the investigation of the winter desiccation of fruit trees. It was found that four distinct pathological conditions exist which heretofore have been attributed to the same cause. An effort was made to differentiate these conditions, and orchard and laboratory studies of their individual causes were undertaken.

The veterinarian in the investigation of hemoglobinuria in cattle made blood and urine examinations and post-mortem studies of diseased animals and also studied the lesions of the bladder to determine the probable cause. Transmission experiments by blood inoculation gave negative results, and attempts to produce growth from the bladder lesions upon artificial media also proved unsuccessful. Pernicious anemia in horses was successfully transmitted from diseased to healthy horses by blood inoculation, but microscopic examinations of the blood have as yet failed to show the causative agent of the disease. Inoculated animals made a complete recovery, and the blood from these animals was found to be innocuous to healthy horses.

Under Hatch and other funds the chemist did considerable analytical work on soils and farm products in connection with various lines of station work.

In agronomy the breeding of cereals on the centener plan was conducted with reference to Mendelian characters, and variety tests were made with oats, wheat, corn, sorghum, peas, soy beans, marrow cabbage, and other crops. Selection work was done with corn, timothy, alfalfa, and varieties of alfalfa, vetches, and grasses were grown in cooperation with this department. Dry farming work was carried on at Ritzville, including experiments on spring versus fall cultivation and other work relating to the treatment of the land to retain moisture, special attention being given to the effect of continuous cropping and fallowing. Rotation experiments were also in progress.

The botanist studied the injury by Bordeaux mixture to plats and conducted spraying experiments with lime-sulphur mixture at Chehalis for apple scab and other fruit diseases. Much attention was given to high-pressure spraying, and the results secured were favorable. The study of the distribution of the fungus diseases in the State was continued.

The horse-feeding experiments conducted by the animal husbandman included the past season the feeding of different combinations of timothy and oats, wheat hay and oats, and alfalfa alone or with barley. Pig-feeding experiments were made to compare tankage with wheat.

The entomologist studied the control of the codling moth in orchard-spraying experiments at Walla Walla and Garfield. Tests were also made with lime sulphur, zinc arsenite, and iron arsenate as a means of control.

The legislature of 1911 passed a stallion registration law requiring that all pure-bred and grade stallions and jacks, kept for public service within the State, shall be registered with the professor of animal husbandry of the State college and provided a registration fee. All moneys collected are to be expended under the direction of the board of regents, and the annual report of such expenditures is to form a part of the annual report of the experiment station.

Preparations were made to separate administratively the farmers' institute and extension work from the experiment station, and beginning with October 1, 1911, all official connection of the director of the station with the administrative work of this department of the college ceased. During the past year members of the experiment station staff gave a limited amount of time for lecturing at farmers' institutes and on farm-demonstration trains.

The publications received from this station during the year were as follows: Bulletins 90, Forest, Shade, and Ornamental Trees in Washington; 91, Wheat and Flour Investigations; 92, Cherries in Washington; 94, Potato Investigations; 98, Commercial Fertilizers; Popular Bulletins 29, The Milling Quality of Washington Wheats, II; 30, Spraying for the Codling Moth; 31, Clover in the Palouse

Country; 32, The Manurial Value of Different Legumes; 36, Field Peas on a Palouse Wheat Farm; 37, Commerical Fertilizers; 38, Corn Growing in Washington; Bulletins 2 (special series), Forage Plants for Western Washington; 3, Root Diseases Caused by *Armillaria mellea* in the Puget Sound Country; 4, Practical Poultry Buildings; 5, Clubroot of Cabbage and Allied Plants; and the Annual Reports for 1909 and 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation	18,146.00
Fees	730.00
Farm products	358.93
 Total	 49,234.93

The definite form of organization of the work of the Washington station has resulted in a very satisfactory condition of affairs and has made possible more regular and systematic research work. Financial assistance given through the board of regents has relieved the institution from embarrassment in connection with the publication of popular bulletins, rentals of tracts of land for experimental work, and other items of similar expenditures.

WEST VIRGINIA.

West Virginia Agricultural Experiment Station, *Morgantown*.

Department of West Virginia University.

E. D. SANDERSON, B. S. A., *Director*.

A number of changes in the staff of the West Virginia station took place during the past year and at its close J. H. Stewart resigned the directorship to take effect January 1, 1912. Shortly afterwards, E. D. Sanderson, dean of the college, was elected director of the station, the two positions being combined.

Work on the seven Adams fund projects in hand was carried on during the year, a large part of the station energies being devoted to these investigations. The apple-leaf disease work was narrowed down to a study of the apple rust mainly. Culture work with the rust was begun, a study of the time and source of infection was carried on, the effect of weather conditions being specially taken into account, and control methods were considered. The destruction of the cedar trees in infested localities as a means of preventing or, to some extent, controlling the disease was confirmed and an experiment with inoculated and rusted fruit in cold, warm, and ordinary storage gave negative results with reference to the spread of the disease.

In studying the factors entering into the production of sanitary milk the germ content of the milk as it leaves the cow's udder was

determined, and a study was also made of the variation of the germ content in the different quarters of the udder. Attempts to reduce the germ content artificially were not very successful.

In connection with the poultry project the time of molting in its relation to the production of chickens of high vigor and the effect of the lack of phosphorus in the feed on the composition of the egg, particularly the shell, were studied. Some analyses were also made of the chicks after hatching.

The studies on the effect of pressure in the preservation of fruits, vegetables, and milk have resulted in getting the death point of bacteria and other organisms under pressure and as related to time and temperature. The effect of pressure on chemical reactions was also investigated. New apparatus of increased efficiency was devised and constructed for further work.

In the work on the artificial fixation of atmospheric nitrogen by means of electrical discharges, the nitric acid yield as the result of the use of a new apparatus was increased to considerably more than has been secured by other investigators.

The study of acidity in soils covered the various methods for determining acidity, and work was done with soils from different parts of the State. The effects of oxidation and aeration on the acidity of soils were studied, but in this connection difficulty was encountered with the methods at hand for measuring small changes in acidity.

The life history of the woolly aphid was worked through from the winter egg to the insect of next season, but sufficient material to secure the winter eggs was not procurable, and this point still remains to be investigated.

Other activities of the station supported by Hatch and State funds included experiments in spraying potatoes with Bordeaux mixture, special attention being given to the preparation of the spraying mixtures. The needs of lime for certain crops were determined and these results were of value also in the study of soil acidity.

Horticultural work continued from previous years comprised a test of varieties, pruning experiments, trials with cover crops, and a study of the cost of production carried on cooperatively in an apple orchard at Lost Creek. A demonstration apple orchard was set out at Berkeley Springs, in which some experimental work will be done, and a plum orchard was established at the station for the study of varieties and culture. The potato work at Reidsville, in cooperation with this department, was moved to Terra Alta, which has an elevation of about 3,000 feet. Hill selection, breeding work, and fertilizer and variety tests were pursued and work was begun to demonstrate the possibility of growing seed potatoes for certain southern localities, and thus to make the use of northern-grown seed unnecessary. Ferti-

lizer experiments with tomatoes at Berkeley Springs gave good results from the use of acid phosphate. Orchard heating and orchard fertilizer experiments were also taken up, and studies were made of apple by-products as a means of disposing of inferior fruit. Methods for combating walking sticks, which had become serious in a big orchard on a piece of cleared land, were given trial.

The poultryman tested a new system of brooding for raising chicks in large quantities and studied the cost of egg production and the cost of producing chickens, special attention being given to the feed required to produce a pound of growth.

The agriculturist carried on fertilizer experiments with a variety of crops and the dairyman conducted a cross-breeding experiment with the dairy herd, using Ayrshire and Curry bulls on Jerseys.

In addition to the cooperative work already mentioned, the station cooperated with swine breeders in the inoculation of hogs to prevent the further spread of hog cholera, and assistance was also given farmers in the control and eradication of internal parasites of sheep. Cooperative poultry work had reference mainly to brooding, feeding, and the use of improved breeds. The station conducted demonstrations in the spraying of orchards and potatoes, for which it receives an appropriation of \$4,000 a year from the State, and further devoted its energies to the inspection of orchards and nurseries under another State appropriation, amounting to \$7,500. The station also continued to have charge of the fertilizer control of the State, and the usual amount of inspection and analytical work was done.

The publications received from this station during the year were as follows: Bulletin 129, Construction of a Silo; 130, Construction of a Modern Poultry House and Report of Experiments in Hopper Feeding Laying Hens; 131, Plat Experiments with Fertilizers; 132, Commercial Fertilizers; and 133, Suggestions for Spraying.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act	\$15,000.00
United States appropriation, Adams Act	15,000.00
State appropriation	11,500.00
Fees	13,251.69
Farm products	7,390.75
Miscellaneous	279.61
Balance from previous year	3,889.76
Total	66,311.81

The West Virginia station with the Federal and State funds is doing a considerable amount of experimental and demonstration work of value to the State, and its investigations in a number of lines are commendable.

WISCONSIN.

Agricultural Experiment Station of the University of Wisconsin, *Madison.*

Department of the University of Wisconsin.

H. L. RUSSELL, Ph. D., *Director.*

The past year at the Wisconsin station witnessed a continued expansion of the resources and of the organization of the institution. A two-story brick building, 48 by 128 feet, was constructed for the departments of horticulture and plant pathology, at a cost of about \$60,000 (Pl. IX, fig. 2). New greenhouse laboratories, provided last year, form a part of the equipment for these departments. The old sheepfold was replaced by an adequate office and storage building, with root cellar below, and a two-story barn, 24.5 by 154 feet. Quarters for the department of experimental breeding were also constructed. A new agricultural chemistry building was authorized for next year. The university acquired by purchase 187 acres of lake-shore land, and a large part of this tract was reclaimed from a marshy condition and brought under successful cultivation.

During the year a number of changes were made in the station staff and in the organization. A separate department of agricultural bacteriology was organized, and E. G. Hastings was made bacteriologist of the station and head of the department. The work in veterinary science was separated from the department of animal husbandry and organized on an independent basis. F. B. Hadley was made station veterinarian and was placed in charge of the new department of veterinary science. J. Y. Beaty was appointed station editor, vice J. C. Marquis, resigned, and C. J. Galpin was selected for research work along social lines as applied to rural problems.

Active work begun at the Spooner substation included the clearing and breaking of most of the station land and the construction of necessary buildings. Work along similar lines was also started at the Ashland Junction substation. Two experimental orchards in this vicinity under the control of the station for the past five years are to be attached for administrative purposes to this substation. A third substation was permanently located at Marshfield on the Colby clay, the soil type predominating in several of the counties in the north-central part of the State. The legislature of 1911 authorized the establishment of three demonstration farms and made the location of these farms contingent upon the county board leasing free to the regents of the university for a period of years a suitable tract of cleared land and appropriating \$500 annually for the partial maintenance of such demonstration farms, while a State appropriation for these farms was made at the rate of \$1,000 per annum for a period of five years for each farm.

Progress was reported on all Adams fund projects, but in most cases the work was only partially completed. The investigation of the efficiency of rations from single-plant sources in animal feeding was continued. Previous work with cattle showed that an exclusive wheat ration was apparently highly injurious, and a study to determine the cause of this effect was pursued with other types of farm animals.

The study of the mineral requirements of farm animals was carried on as in previous years. The normal grain feeds were found to contain insufficient lime for the best development of growing animals, and the addition of floats, ground limestone, or finely ground leguminous hay, such as alfalfa or clover, were especially helpful in developing a strong skeleton. The experimental results further indicated that mature swine, not forming new muscular tissue, or undergoing such physiological processes as milk secretion and reproduction, can be maintained in a normal condition on a low lime supply. Magnesium salts directly injected into the blood of swine, or added with the food as sulphates or chlorids, produced an increased excretion of calcium in the urine. When feeds containing a large amount of magnesium as compared to their content of calcium were used, this increased calcium excretion did not occur.

The soils department in the study of conditions affecting the availability of untreated rock phosphate, used as a fertilizer, found that when this substance and manure are composted, the solvent action of the organic matter on the phosphate is slight. When the carbon dioxid produced by the composting of the manure was brought into direct contact with rock phosphate held in suspension in water, the solvent action was much greater. It was further found that the process of solution in either of these conditions soon reaches an equilibrium and no further solution takes place. It is concluded that the availability of rock phosphates to plants can not be determined by its solubility in acid solvents, such as a 0.2 per cent citric acid. In a study of the relation of bacteria to the solubility of rock phosphate in fermenting manures, a reduction in the amount of soluble phosphorus was noted and found to be directly associated with bacterial cell development. An investigation of oxidation and heat in their relation to the solubility of soil phosphorus showed that 80 to 90 per cent of the organic matter can be removed from a soil by oxidation with hydrogen peroxid. After the destruction of this amount of organic matter, the increase in the solubility of the phosphorus in fifth normal nitric acid was 30 to 50 per cent of the total phosphorus. Heat did not increase the solubility so much and did not increase it at all after the action of hydrogen peroxid. In this connection, attention was also given to the solubility of iron, aluminum, calcium, and manganese.

The investigation of the rôle of bacteria in the manufacture and ripening of Cheddar cheese was carried forward, and, among other results secured, it was found that the period of activity of the lactic-acid bacteria occurs before characteristic flavor has developed in the cheese. A study was therefore made of the rod-shaped or high-acid producing organisms which followed the development of lactic-acid bacteria and increased in such numbers as to make 50 to 90 per cent of the total bacterial content to determine their influence of flavor production. In this connection, other groups of bacteria, such as colored coccus forms, were also taken into account.

With the Hatch and miscellaneous funds a number of lines of experimental work were pursued. The animal-husbandry department continued its work with grain mixtures for fattening wethers for show-yard competition, and carried on experiments in which the value of soiling crops and corn silage as means of supplying summer feed to the dairy herd was compared. The soiling crops, sown from April to June and fed during the dry season from July to September, consisted of a mixture of peas and oats, sweet corn, and field corn. A consideration of all the factors involved indicated the profitableness of having corn silage available for summer feed up to the time the crop reaches the milk stage.

The horticultural department reported a number of investigations in plant breeding, including the development of a forcing cucumber by crossbreeding and also developing tomatoes for forcing and for resistance to the mosaic disease. Data on the segregation of crosses were collected, and two generations of pure strains of tomatoes from large and small seeds were studied. A number of new varieties of plums and apples were propagated for distribution for final testing, and tobacco-breeding work was conducted with 12 to 15 strains of Improved Connecticut Seed Leaf. An investigation of the troubles in the tobacco seed bed was made, and extensive experiments were undertaken in spraying cherry trees with Bordeaux mixture and lime sulphur, to test the efficiency of the two fungicides for the control of the fungus diseases of the cherry.

The work in agronomy consisted largely of testing pedigreed barleys, oats, corn, and rye. Plant breeding was carried on extensively, about 200 acres being devoted to the work. All the important cereals and field peas were included in the breeding experiments, and an attempt was made to determine some of the principles underlying plant breeding. Experiments were also in progress with alfalfa, clovers, grasses, fertilizers, methods of cultivation, rotations, weed control, and in other similar lines. This department also had charge of the seed-control work of the State.

In entomology, special attention was given to truck-crop insects, particularly the onion thrips, and work was also in progress on the cranberry worm, which has been quite destructive. The hatching record and early life history were worked out. A new nursery-stock law went into effect last year, and this department had charge of the inspection. A small insectary was built during the spring.

In plant pathology, studies on the life history of *Phytophthora infestans* were continued, and work along a number of important lines was inaugurated. These included studies of the relation of fungicides to spore germination, a *Fusarium* disease of cabbage, and a number of other plant diseases.

The department of farm engineering studied the effect of silage on concrete with a view to protecting the concrete walls against injury from this source. The station cooperated with farmers in the State by loaning them forms for the construction of concrete silos. About 25 were built during the past season.

The dairy department, among other work, gave attention to the elimination of mottles in butter, tested a homogenizing device for the treatment of cream, and gave attention to the improvement in quality of the milk supply by the application of the score-card system on 200 farms supplying milk to the university. The new method of utilizing buttermilk for making a soft-cheese product, devised by the department, has been in commercial use over a year, with satisfactory results.

The demonstration work, farmers' cooperative projects, general extension instruction, and the inspection and control work include many different lines of activity. Demonstrations were carried on on State and county farms, at the northern substations, on farms in the use of fertilizers and the conservation of manure, hog-cholera vaccine work, potato spraying, cooperative silo building, testing dairy cows, scoring butter and cheese, and milk and cream testing. The inspection and control work included stallion registration, feeding stuff and fertilizer control, and nursery and seed inspection.

The publications received from this station during the year were as follows: Bulletins 196, Opportunities for Profitable Farming in Northern Wisconsin; 197, Methods of Paying for Milk at Cheese Factories; 198, Methods of Renting Farm Lands in Wisconsin; 199, The Principles and Practice of Land Drainage; 200, The Selection of Feeds for Dairy Cows; 201, Planting the Commercial Orchard; 202, The Management of Heavy Clay Soils; 203, Report of the Director, 1910; 204, The Improvement of Sandy Soils; 205, The Development of Marsh Soils; 206, Tobacco Culture in Wisconsin; 207, The Management of a Bearing Orchard; 208, Crop Demonstrations on State and County Farms; 209, The Prices of Farm Products; 211,

Buttermilk-cheese Making at the Creamery; 212, Barley Culture in Wisconsin; Research Bulletins 10, Some Improved Methods of Dairy Chemistry Analysis; 11, The Production of Volatile Fatty Acids and Esters in Cheddar Cheese and Their Relation to the Development of Flavor; 12, Some Factors Concerned in the Fixation of Nitrogen by Azotobacter; 13, Studies of the Protein Requirements of Dairy Cows; 14, Sulphur Requirements of Farm Crops in Relation to the Soil and Air Supply; Circulars of Information, 17, Draft-horse Judging; 18, The Curing and Testing of Seed Corn; 19, The Control of Quack Grass and Canada Thistles; 20, The Control of Moisture in Cheese; 21, Distribution of Licensed Stallions in Counties of Wisconsin; 22, Chemical Analyses of Licensed Commercial Feeding Stuffs, 1910; 23, A Catechism of Bovine Tuberculosis; 24, Commercial Feeding Stuffs and Fertilizers Licensed for Sale in Wisconsin, 1911; and 25, Analyses of Licensed Commercial Fertilizers, 1911.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000
United States appropriation, Adams Act-----	15,000
State appropriation-----	15,000
Fees-----	10,324
Farm products-----	9,000
 Total-----	 64,324

The expansion in equipment and organization which the Wisconsin station enjoys enables the institution to meet with greater readiness the many demands arising from the great range in the character and quality of the agricultural operations of the State.

WYOMING.

Wyoming Agricultural Experiment Station, Laramie.

Department of the University of Wyoming.

H. G. KNIGHT, A. M., *Director.*

During the past year the Wyoming station made good progress in its different lines of work, but in most instances a point of completion was not reached. There were no changes in the various departments of the station and the work started or in progress a year ago was carried on continuously. During the year L. D. Swingle was placed in charge of the new department of parasitology. The systematic improvement of the fertility of the station farms was entered upon during the season.

The Adams fund work of the station was reorganized during the past year and progress was made along the several lines. The wool

investigations were largely confined to the study of methods for testing and comparing wools and devising apparatus for this purpose, and to determine the variability in breaking strain in wool fiber. A first paper on these studies was published in the twenty-first annual report of the station.

The new department of parasitology took up the life-history study of the sheep tick and, from the preliminary experiments made, it was evidenced that the stages in the life history of this insect are very greatly modified by changes of temperature.

The studies of poisonous plants resulted in the isolation in crystalline form of the toxic principle of the death camus (*Zygadenus intermedius*). A report of the proximate analyses of the different parts of the species available in Wyoming was published.¹ In the preliminary work various methods were used in securing the alkaloid with a view to subsequently isolating a larger quantity by the method found most suitable. Special attention was given to the determination of alkaloid in the leaf and in the bulb of the plant. The resinous matter present in the leaf was found to be nonpoisonous and the results further showed that the flower contained the highest percentage of alkaloid, while the bulb contained a relatively large amount of sugar.

A chemical examination of woody aster was also made and the toxic effects of the plants in general were determined. A report on the analyses of the different parts of the plant was made at the close of the year. While the toxic effects were quite well established, no definite results were obtained in regard to the toxic principles. In these studies the animal pathologist cooperated with the station chemist.

Among the lines of work carried on with other funds may be mentioned the work of the agronomist with oats, barley, spring and winter wheat, flax, rye, field peas, and corn under different experiments, such as deep and shallow plowing, manuring and nonmanuring, spring and fall plowing, and other tests of a similar nature. Fifty-three varieties of barley received from this department were tested as to their adaptability to high and dry altitudes. Extensive tests were in progress with sweet clover grown for hay and for green manure. This crop was found adapted to alkaline soil and also to dry farming conditions. It was found successful under conditions which were unfavorable to the growth of alfalfa. Irrigation experiments were conducted in conjunction with the irrigation engineer for the purpose of determining the optimum amount of water upon oats, barley, field peas, milo maize, sugar beets, field beets, rutabagas, and turnips. Fertilizer tests with different crops were also in progress

¹ Jour. Amer. Chem. Soc., 33 (1911), No. 2.

and cooperative work in dry farming was carried on. Most of these experiments were interfered with by an early frost which damaged the crops. This department made tests of about 75 varieties of grass, grain, and vegetable seeds during the year.

In animal husbandry, feeding experiments were made with lambs and an account of the work was prepared for publication. The lambs were fed in five lots of 32 each and corn alone was compared with linseed-oil cake against alfalfa meal combined with corn. A number of digestion experiments were made to determine the coefficients for Wyoming forage plants. A cooperative breeding experiment with polled Hereford cattle and pasture experiments with alfalfa, peas, rape, and similar crops for pigs were in progress in cooperation with the station chemist.

The forage-plant investigation by the chemist, which was closed early in the year, was a continuation of an earlier study to determine the chemical composition of some of the native forage plants of the State, but in the more recent work account was taken of the effect of altitude upon the composition of the plants. It was observed in general that the crude protein and nitrogen-free extract content of forage plants increases while the percentage of crude fiber decreases with an increase of altitude. The relation of organic matter to bacterial activity in soils was also studied, and while considerable work has been done conclusions have not yet been drawn.

The irrigation engineer completed a study of the reclamation by means of underdrainage and leaching of a badly water-logged and alkali-laden portion of the stock farm, and made a report upon this work.

The station veterinarian, in addition to cooperative and other Adams fund work, prepared over 600 tissue specimens obtained from the season's post mortems, and the study of these was carried on as rapidly as time permitted. Various inquiries were made during the year as to the manufacture and distribution of vaccines by the station for prevention of disease, and some few vaccines of both the stock and autogenous types were prepared.

The station undertook little cooperative and extension work during the year. One demonstration farm, located at Wheatland, was supervised by the station and conducted with funds from private sources. A large amount of machinery was loaned by manufacturers for use in demonstration work and also in the experimental work upon the station farms.

The publications received from this station during the year were as follows: Bulletins 85, Feeding Experiments, 1909-10; 86, Potatoes; 87, Wyoming Forage Plants and Their Chemical Composition—Studies No. 4; 88, Woody Aster; and the Annual Report for 1910.

The income of the station during the past fiscal year was as follows:

United States appropriation, Hatch Act-----	\$15,000.00
United States appropriation, Adams Act-----	15,000.00
Farm products, including balance from previous year-----	6,717.52
Total-----	36,717.52

Good progress was made during the past year in reorganization work of the Wyoming station and in strengthening some of its departments. The administrative affairs of the institution have been placed on a systematic basis.

STATISTICS OF LAND-GRANT COLLEGES AND AGRICULTURAL EXPERIMENT STATIONS, 1911.

By BUTLER B. HARE, *Assistant in Agricultural Education.*

The following statistical statements relate to the institutions established under the acts of Congress of July 2, 1862, and August 30, 1890, most of which maintain courses of instruction in agriculture, and to the agricultural experiment stations, which, with few exceptions, are organized under the act of Congress of March 2, 1887, and are conducted as departments of the institutions receiving the benefits of the land-grant act of 1862. These statistics have been compiled in part from the annual reports of the presidents of these institutions made on the schedules prescribed by the Commissioner of Education. Tables showing the annual disbursements on account of the acts of Congress of March 2, 1887, August 30, 1890, March 16, 1906, and March 4, 1907, prepared from figures furnished by the Departments of the Treasury and the Interior, are also included. Owing to the complex organizations of many of the institutions, it is impracticable to give exactly comparable statistics in all cases, and in some instances the data furnished are incomplete.

SUMMARY OF STATISTICS OF LAND-GRANT COLLEGES.

Educational institutions receiving the benefits of the acts of Congress of July 2, 1862, August 30, 1890, and March 4, 1907, are now in operation in all the States and Territories except Alaska. The total number of these institutions is 67, all of which maintain courses of instruction in agriculture. The aggregate value of the permanent funds and equipment of the land-grant colleges and universities in 1911 is estimated to be as follows: Land-grant fund of 1862, \$13,533,885.92; other land-grant funds, \$3,320,958.36; other endowment funds, \$19,053,289.02; land grant of 1862 still unsold, \$5,300,563.37; farms and grounds owned by the institutions, \$21,480,453.34; buildings, \$40,011,931.74; scientific apparatus, machinery, and furniture, \$11,855,122.13; libraries, \$5,335,051.53; live stock, \$741,077.19; total, \$120,632,332.60. The income of these institutions in 1911, exclusive of the funds received from the United States for agricultural experiment stations (\$1,365,913.29), was as follows: Interest on land-grant funds of 1862, \$802,208.12; interest on other land-grant funds, \$398,520.69; United States appropriation under acts of 1890 and 1907,

\$2,265,199.54; interest on endowment or regular appropriation, \$303,-682.91; State appropriation for current expenses, \$7,860,107.03; State appropriation for increase of plant, \$3,132,859.19; income from endowment, other than Federal or State grants, \$749,507.15; tuition and incidental fees, \$3,407,695.23; private benefactions, \$1,269,934.42; miscellaneous, \$1,819,978.40; total, \$22,427,111.88. The value of the additions to the permanent endowment and equipment of these institutions in 1911 is estimated as follows: Permanent endowment, \$846,-190.76; buildings, \$2,788,911.11; libraries, \$317,448.99; apparatus, \$529,980.88; machinery \$414,803.31; live stock, \$133,368.70; miscellaneous, \$532,790.15; total, \$5,563,493.90.

The number of persons in the faculties of the colleges of agriculture and mechanic arts for white persons was as follows: For preparatory classes, including secondary schools of agriculture, 568; for collegiate and special classes in agriculture, mechanic arts, and in all other instruction, 3,343; total, counting none twice, for interior instruction, 3,726. There were also 41 instructors giving full time and 406 giving part time to agricultural-extension work, 1,437 experiment station officers, and 2,331 persons in the faculties of other colleges or departments, making a grand total, counting none twice, of 6,802 persons engaged in instruction and research in the land-grant institutions.

The number of persons in the faculties of the colleges of agriculture and mechanic arts for colored persons was as follows: For preparatory classes, 157; for collegiate and special classes, 245; total, counting none twice, 374. In the other departments the faculties aggregated 86, making a grand total of 460 persons in the faculties of the institutions for colored persons.

The students in 1911 in the colleges for white persons were as follows: (1) By classes—preparatory or secondary schools of high-school grade, 7,042; collegiate, 27,616; postgraduate, 660; one to two year and winter courses, 8,991; summer courses, 2,042; total, counting none twice, in interior courses, 45,871. There were also enrolled in correspondence courses, 61,709; in extension courses of five days or longer, away from college, not including farmers' institutes, 81,082; in all other departments of the institutions, 35,191; total number of students, counting none twice, receiving instruction from these institutions, 249,955. (2) By courses: Four year—agriculture, which may include a number of students pursuing courses in dairy-ing, animal husbandry, poultry husbandry, or other allied courses, 7,796; horticulture, 243; forestry, 449; veterinary science, 266; household economy, 2,258; engineering, 15,555. Shorter than four years—agriculture, 6,775; horticulture, 565; forestry, 411; total, counting none twice, 7,751; veterinary science, 418; household economy, 958;

teachers' courses in agriculture, 745 (one to three year, 249; summer schools of agriculture, 496); mechanic arts, 695; military tactics, 20,117.

The students in colleges and schools for colored persons were as follows: (1) By classes—preparatory, 6,273; collegiate, 864; short or special, 768; other departments, 291; total, 8,138. (2) By courses—agriculture, 2,257; teachers' courses in agriculture, 159 (one to four year, 27; summer schools, 132); industrial courses for boys, 2,712; industrial courses for girls, 5,456; military tactics, 2,292.

The graduates in 1911 in the institutions for white persons were as follows: Agriculture, 860; mechanic arts, 2,265; all other courses, 4,192; total, 7,317. The total number since the organization of these institutions is 95,512. The graduates in the institutions for colored persons were 260, and the total number since the organization of these institutions is 7,337. The total number of volumes in the libraries was 2,685,481, and the total number of pamphlets 808,727. The total number of acres of land granted to the States under the act of 1862 was 10,570,842, of which 979,842 are still unsold.

SUMMARY OF STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the acts of Congress of March 2, 1887, and March 16, 1906, in all the States and Territories, and under special appropriation acts in Alaska, Hawaii, Porto Rico, and Guam.

In Alabama, Connecticut, Hawaii, Louisiana, Missouri, New Jersey, New York, North Carolina, and Virginia separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the 48 States is 59, and in the United States, including Alaska, Hawaii, Porto Rico, and Guam, 65. Of these, 50 receive appropriations provided for by acts of Congress approved March 2, 1887, and March 16, 1906, and 4 by other Federal enactments.

The total income of the stations maintained under the acts of 1887 and 1906 during 1911 was \$3,662,425.05, of which \$1,440,000 (Hatch fund, \$720,000; Adams fund, \$720,000) was received from the National Government, the remainder, \$2,175,425.05, coming from the following sources: State governments, \$1,246,470.32; individuals and communities, \$80,483.54; fees for analyses of fertilizers, \$144,031.48; sales of farm products, \$202,687.87; miscellaneous, including all balances, \$548,751.84. In addition to this, the Office of Experiment Stations had an appropriation of \$424,000 for the past fiscal year, including \$30,000 each for the Alaska, Hawaii, and Porto Rico Experiment Stations, \$15,000 for the Guam Experiment Station, \$15,000

for nutrition investigations, \$100,000 for irrigation investigations, \$100,000 for drainage investigations, and \$10,000 for farmers' institutes and agricultural schools. The value of the additions to the equipment of the stations in 1911 is estimated as follows: Buildings, \$448,708.75; libraries, \$30,148.02; apparatus, \$74,847.74; farm implements, \$54,689.53; live stock, \$99,594.68; miscellaneous, \$231,717.04; total, \$939,705.76.

The stations employ 1,564 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 57; assistant directors, 22; chemists, 293; agriculturists, 32; agronomists, 139; animal husbandmen, 101; dairymen, 77; veterinarians, 57; entomologists, 107; botanists, 84; horticulturists, 131; poultrymen, 32; plant pathologists, 54; zoologists, 10; meteorologists, 9; pomologists, 5; foresters, 22; mycologists, 2; biologists, 9; geologists, 2; plant breeders, 12; bacteriologists, 58; animal pathologists, 8; viticulturists, 3; soil specialists, 34; irrigation engineers, 22; agricultural engineers and farm mechanics, 21; extension work and farmers' institute directors, 27; in charge of substations, 54; farm and garden foremen, 62; secretaries and treasurers, 33; and librarians, 19.

There are also 59 persons classified under the head "Miscellaneous," including gardeners, laboratory and field assistants, herdsmen, editors, inspectors, etc. Five hundred and fifty-two station officers do more or less teaching in the colleges with which the stations are connected. During the year the stations published 566 annual reports, bulletins, and circulars, which were supplied to over 1,012,520 addresses on regular mailing lists. Most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

STATISTICS OF THE LAND-GANT COLLEGES AND UNIVERSITIES.¹

Unless otherwise specified, the statistics reported in the tables are for the institutions as designated in the list given below.

TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study.*

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Degree courses. ²	Preparatory and short courses.
Alabama.....	Alabama Polytechnic Institute.	Auburn.....	C. C. Thach, M. A., LL. D.	Agr., civil engin., archt., elect. engin., mech. engin., mining engin., phar., general chem., and metal. (B. S.); phar. (2 yrs., Ph. G., 3 yrs., Ph. C.); vet. med., and surgery (3 yrs., D. V. M.). Sci., agr., mech. (B. S.).....	Agr., mech. arts (2 yrs.), agr. (1 yr.), summer school for farmers (10 days).
Agricultural and mechanical College for Negroes.	Normal.....	Normal.....	W. S. Buchanan, B. S. A.	Indus. and lit. studies (1 to 4 yrs.), teachers, training course; com. course.	
Arizona.....	University of Arizona.	Tucson.....	Arthur H. Wilde, Ph. D.	Agr. (2 yrs.), prep. (4 yrs.).	
Arkansas.....	University of Arkansas.	Fayetteville.....	J. N. Tillman, LL. D.	Lit. (A. B.) sci., metal, mining engin., civil engin., mech. engin., elect. engin., agr. (4 yrs.), (B. S.). Agr. (B. S. A.), mech. engin. (B. M. E.), elect. engin. (B. E. E.), civil engin. (B. C. F.), mining engin. (B. Mi. E.), chem. engin. (B. Ch. E.), chem. (B. S. C.), phys. (B. S. in Phys.) lit. and sci. (B. A. and B. S.), music (B. Mus.), normal (L. I.), Clas. (B. A.), normal (L. I.).....	Agr., hort., dairying, elect. engin. (2 yrs.), mech. arts (2 or 3 yrs.), prep. (1 yr.), agr. (3 weeks), art. (1 yr. and 4 yrs.); cor. course in agr.
* Branch Normal College.	Pine Bluff.....	Isaac Fisher ³			Prep. (2 yrs.), manual training, mech. arts (4 yrs.).
California.....	University of California.	Berkeley.....	B. L. Wheeler, Ph. D., LL. D.	Letters (A. B.), social sci. (B. L.), natural sci., commerce, general and tech. agr. (4 yrs. each), mech. engin., elect. engin., mining and metal. (B. S.) (4 and 5 yrs. each). Agron.; animal hush., ent., forestry, hort., mech. engin., civil and irrig. engin., elect. engin., general sci., home econ. (B. S.). vet. sci. (D. V. S., 3 yrs.).	Agr., animal indu., and vet. sci., irrig., poultry hush., dairying, nutrition, ent., vit., hort. (2-8 weeks each) summer session (6 weeks), farmers' week.
Colorado.....	The State Agricultural College of Colorado.	Fort Collins.....	C. A. Lory, M. S., LL. D.		Agr., mech. arts, domestic sci. (3 yrs. of 6 months each; optional fourth year of 6 months for college entrance), farmers' and dom. sci. week.

¹ Including also institutions receiving apportionments from the appropriations of 1890 and 1907.

² Four-year courses unless otherwise specified.

³ Principal.

TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.*

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Degree courses. ¹	Preparatory and short courses.
Connecticut.....	Connecticut Agricultural College.	Storrs.....	C. L. Beach, B. Agr., B. S.	Agr. (including dairy and poultry husb. and hort.) (4 yrs., diploma with 2 yrs. of previous preparation in high school), school of mech. arts, agric., home econ. (2 yrs. each), summer school of nature study and agr. (4 weeks), dairy and poultry husb., porciculture (winter, 6 weeks).	Agr. (2 yrs.), farmers' week, 8 weeks' course in agr. Normal (4 yrs.), industrial prep. (2 yrs.).
Delaware.....	Delaware College.....	Newark.....	G. A. Harter, M. A., Ph. D.	Class., Let. sci. (B. A.), agr., general sci., civil engin., mech. engin., elect. engin. (B. S.).	Agr., mech. arts, pedag. (2 yrs.), prep. (1 yr.), summer school for teachers (6 weeks), corres. course in agr. for teachers and farmers, farmers' short course (12 weeks).
	State College for Colored Students.	Dover.....	W. C. Jason, A. M., D. D.	Lit. (B. A.), pedag. (B. A. in Ed.), gen. sci., agron., hort., animal husb., agr. chem., agr., pedag., mech. engin., elect. engin., oil engin. (B. S.), law (LL. B.).	English, normal (2 yrs.), high school (3 yrs.), grammar school (3 yrs.), industr. and agr. training through all courses, corres. course in agr., and laboratory courses in gen. agr., dairying (1 yr.), agr. (winter, 12 weeks), cotton grading (Jan. and June, 5 weeks each), cotton school (winter, 10 days), and stockmen's short course.
	University of Florida.....	Gainesville.....	A. A. Murphree, A. M., LL. D.	N. B. Young, M. A.	Normal (3 yrs.), industrial prep. (3 yrs.), dairying (1 yr.).
Florida.....	Florida Agricultural and Mechanical College for Negroes.	Tallahassee.....	Sci. (B. S.).....	A. M. Sonle, B. S. A., D. Sc.	Agr. (3 yrs.), dairying (com 1, 1 yr.), forest rangers (winter), home econ. (3 yrs.).
Georgia.....	Georgia State College of Agriculture and Mechanic Arts.	Athens.....	R. R. Wright, A. M., LL. D.	General sci., agr., civil engin., elect. engin., forest engin. (B. S.), pharm. (2 yrs., F.H.C.).	Schl. agr., home econ., engin. (B. S.), agron., animal husb., dairying, hort., forestry (B. S.), agr., domestic econ. (B. S. D. E.), civil engin. (B. S. C. E.), mining engin. (B. S. Min. E.), elect. engin. (B. S. E.), mech. engin. (B. S. M. E.), chem. engin. (B. S. Chem.), law (3 yrs., LL. B.).
Hawaii.....	Georgia State Industrial College.	Savannah.....	J. W. Gilmore, M. S. A., J. A. MacLean, Ph. D., LL. D.	Collegeiate (A. B.).....	
Idaho.....	College of Hawaii.	Honolulu.....		Schl. agr., home econ., engin. (B. S.), agron., animal husb., dairying (B. S.), agron., animal husb., dairying, hort., forestry (B. S.), agr., domestic econ. (B. S. D. E.), civil engin. (B. S. C. E.), mining engin. (B. S. Min. E.), elect. engin. (B. S. E.), mech. engin. (B. S. M. E.), chem. engin. (B. S. Chem.), law (3 yrs., LL. B.).	
Moscow.....	University of Idaho....	Moscow.....			

Illinois.....	University of Illinois..	E. J. James, Ph. D., L.L.D.	Lit and arts, general sci. (B. A.), archi., engin., archit., decoration, civil engin., elect., engin., mech. engin., railway engin., municipal and industrial engin., mining engin., ceramics, ceramic engin., chem., chem. engin., sci., agr., household sci., landscape gard. (B. S., 5 yrs.) med. (M. D.), libr. sci. (B. L. S., 5 yrs.) med. (M. D.), dentistry (3 yrs., D. S.), pharm. (2 yrs., Ph. G.), law (3 yrs., LL. B.), pharm. chem. (2 yrs., Ph. C.).	Summer school, including secondary and agr., for rural teachers (6 weeks) agr. and domestic sci. (2 weeks), butter makers' course (4 weeks.)
Indiana.....	Purdue University	W. E. Stone, Ph. D., L.L. D.	La Fayette.....	Agri. and hort., animal husb., dairy husb., agri. dom. sci., and agr. (winter, 8 weeks), butter making (10 days, winter), farmers' week.
Kansas.....	Kansas State Agricultural College.....	E. W. Stanton, M. S., L.L. D. ²	Iowa.....	Agri. (2 yrs.) mining engin., clay working (2 yrs.), prep. (1 yr.), dairying (1 yr.), poultry husb. (1 yr.), dairying (16 weeks), grain judging, stock judging, domestic soon., horst. and forestry, agr., engin., dairy, poultry husb. (winter, 2 weeks each), summer vacation school of road investigation; agr.; animal husb., dairying, horst., mammal training, house-hold econ. (summer, 2 weeks)
Kansas.....	Kansas State Agricultural College.....	H. J. Waters, B.S.A.	Manhattan.....	Agtron., animal husb., dairy husb., hort. and dom. sci., mech. engin., general sci., elect., engin., civil engin., archit., Ind., jour., printing (B. S.), vet. med. (D. V. M.)
Kentucky.....	State University.....	Henry S. Barker, L.L. D.	Lexington.....	Clas. (A. B.) mech. engin. (B. M. E.), civil engin. (B. C. E.) mining engin. (B. E. M.), agr. (B. S., Agr.), sci., dom. sci. (B. S.), education (B. S., Educ. and A. B. Educ.), law (3 yrs., LL. B.).
Louisiana.....	The Kentucky Normal and Industrial Institute for Colored Persons.	J. S. Hathaway, A. M., M. D.	Frankfort.....	Agri., elect. engin., chem. engin., civil engin., mech. engin., general sci., premed. (B. S.), commerce, Lat. sci., lit., philos., psychol. and ed. (B. A.) sugar engin. (5 yrs., B. S.), law (3 yrs., LL. B.), law (3 yrs., B. C. L.), law (3 yrs., LL. B.), law (3 yrs., B. C. L.),
Louisiana.....	Louisiana State University and Agricultural and Mechanical College.	T. D. Boyd, A. M., L.L.D.	Baton Rouge.....	Normal (3 or 4 yrs.), agr., carpentry, cooking, music, dressmaking, printing, blacksmithing, wheelwrighting (3 years), busi- ness (2 yrs.), manual training courses in mech. draw., agr., printing, carpentry, sew. and cooking.
Louisiana.....	Louisiana State University and Agricultural and Mechanical College.			Agr. (3 yrs., agr., 2 weeks winter) summer school including agr. for teachers and others (9 weeks).

¹ Four-year courses unless otherwise specified.

TABLE 1.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study*—Continued.

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory. (contd.)	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Degree courses. ¹	Preparatory and short courses.
Louisiana.	Southern University and Agricultural and Mechanical College.	New Orleans.	H. A. Hill.	Scientific (B. S.), classical (A. B.).....	Sci., agr., high school, printing, girls' indus. (2 yrs.), class, normal, manual training, grammar, mech. drawing, typesetting, bookbinding, wheelwrighting, dom. sci. (3 yrs.), book-keeping, typewriting (2 yrs.), music (6 yrs.), agr. (1 yr. for students over 18 yrs.). Secondary agr. (2 yrs.), agr. for teachers (1 yr.), dom. sci. for teachers (2 yrs.), agr. and dairying (4 weeks), poultry management, hort., and dom. sci. (3 weeks), spring), summer school for teachers (6 weeks), farmers' week, reading and correspondence courses in agr. and dom. sci. Agr., hort. (2 yrs.), prep. (1 yr.), agr. and hort. (winter, 10 weeks).
Maine.	University of Maine.	Orono.	R. J. Aley, Ph.D.	Clas., sc., (B. A.) agron., animal husb., hort., dom. sci. chem., civil engin., mech. engin., elect. engin., chem. engin., forestry, phar., el. agr. for teachers (B. S.), law (3 yrs., LL. B.), phar. (2 yrs., Ph. C.).....	College prep. and normal (4 yrs.), grammar (2 yrs.), indus. courses in agr., dairying, blacksmith., wheelwr., carpentry, printing, dom. sci. and art.
Maryland.	Maryland Agricultural College.	College Park.	R. W. Sylvester, M. S., LL.D.	Agron., animal husb., hort., chem., gen. course, biol., mechan. engin., civil engin., elect. engin. (B. S.).....	Agr., hort., floriculture, dairying (winter, 10 weeks), poultry met., (2 weeks), bee-keeping (May, summer school of agr., et al. (2, 4, and 6 weeks), farmers' week, corresps. course.
	Princess Anne Academy for Colored Persons.	Princess Anne.	T. H. Kiah.	.....	Prep. (1 yr.), agr. for teachers (1 yr.), cheese making (4 weeks), general agr., poultry husb. (2 winter terms of 8 weeks each), creamery (2 winter terms of weeks each), hort. (4 weeks, winter), forestry (2 summer terms of 6 weeks each), college ext. reading course.
Massachusetts.	Massachusetts Agricultural College.	Amherst.	K. L. Butterfield, A. M., LL.D.	Agr. (B. S.).....	
	* Massachusetts Institute of Technology.	Boston.	R. C. MacLaurin, M. A., LL. D., D. Sc.	Civil engin., mech. engin., mining engin., and metal., archt., chem., elect. engin., biol., phys., electro-chem., chem. engin., sanitar., engin., geol. and geodesy, naval archt., general sci. (B. S.).....	
Michigan.	Michigan State Agricultural College.	East Lansing.	J. L. Snyder, Ph. D., LL. D.	Agr., engin., hort., forestry, home econ. (B. S., each 4 and 5 yrs.), vet. sci. (D. V. S.).....	Prep. (1 yr.), agr. for teachers (1 yr.), cheese making (4 weeks), general agr., poultry husb. (2 winter terms of 8 weeks each), creamery (2 winter terms of weeks each), hort. (4 weeks, winter), forestry (2 summer terms of 6 weeks each), college ext. reading course.

Minnesota.....	The University of Minnesota.....	G. E. Vincent, Ph. D., LL.D.	Set, lit., and arts (B.A.), civil engin. (C.E.), mining, engin. (M.E.), elect. engin. (E.E.), metallurg., met. (M.), Met. E., chem. (B.S. in Chem.), agr. (B.S.), forestry (B.S.). Agr., agr. (summer, 6 weeks).	See, agr. (3 yrs.), agr. (4 weeks), forestry, dairying (winter, 4 weeks), traction engine, (4 weeks), el. agr., nature study and dom. sci. and art for teachers (summer, 6 weeks).
Mississippi.....	Agricultural College.	J. C. Hardy, A. M., LL.D.	Carp., blacksm., (4 yrs.), shoemak., nurse training, paint, dom. sci. millinery, etc. (3 yrs.), agr. (2 yrs.), prep. (2 yrs.), primary (3 yrs.).	Agr., mech. arts, textile (2 yrs.), prep. (1 yr.), pract. working boys' course (1 yr.), agr. (10 weeks), summer normal school for teachers (4 weeks), agr. (summer, 2-4 weeks), teachers' short course in pedag., agr., manual training.
Mississippi Agricultural and Mechanical College.	Alcorn.	J. A. Martin, A. M.	Carp., blacksm., (4 yrs.), shoemak., nurse training, paint, dom. sci. millinery, etc. (3 yrs.), agr. (2 yrs.), prep. (2 yrs.), primary (3 yrs.).	Agr., (winter, 2 yrs., of 14 weeks each), mining and assaying, electricity, surveying (2 yrs. each), summer school for teachers (9 weeks), poultry bush. (winter, 2 weeks), farmers' week.
University of Missouri.	Columbia.....	A. R. Hill, A. M., Ph. D., LL.D.	Gen. sci. (B. A.), agr., (B. S., C. E.), mech. engin. (B. S., E. E.), civil engin. (B. S., E. E.), chem. engin., chem., and metal., journalism, educ. (B. S.), law (3 yrs., LL. B.). Collegiate (B. A.)	Normal, subnormal (4 yrs. each), indus. draw., carpentry, blacksmithing, mach. and engin. (2 yrs.), summer school (9 weeks), music (8 grades).
Missouri.....	Lincoln Institute.....	B. F. Allen, A. M., LL.D.	Prep., music, art (3 yrs.), agr. (3 yrs.), dom. sci. (1 yr.), creamery (4 weeks), dairying, stock judging, dom. sci. (1 week each).	Vocational agr., home econ. (4 yrs. each), high and normal and grade and rural school teachers' courses in agr., home econ., and manual training (1 yr. each), home econ. for teachers (2 yrs.), agr. (winter, 7 weeks), teachers' summer school, including agr. and home econ. (8 weeks), Prep.
Montana.....	Montana State College of Agriculture and Mechanic Arts.	J. M. Hamilton, M. S.	Mech. engin. (B.M.E.) elect. engin. (B.E.E.), civil engin. (B.C.E.), agron., animal husb., and dairying, hort., home sci., chem., biol., math.-phys., history-lit., phar., sec.-retarial (B. S.), phar. (2 yrs., Pl. C.). Clas., lit. (B. A.), general set, general agr., home econ., agr. engin., civil engin., elect. engin., municipal engin., mech. engin., forestry, phar. (B. S.), teachers' course (B. A. and B. S.), med. (M.D.), law (3 yrs., LL.B.), phar. (3 yrs., Ph. C., 2 yrs., Pl. G.). Liberal arts (B. A.), mining engin., agr., domestic sci., mech. engin., civil engin., general sci. (B. S.).	Agr. (2 yrs.), dairying (winter, 10 weeks), farmers' week.
Nebraska.....	University of Nebraska.	Samuel Avery, Ph. D. Lincoln.....	J. E. Stubbs, M. A., D. D., LL.D.	Clas. (A. B.), Lat. sci. (Litt. B.), general sci., agr., civil engin., mech. engin., elect. engin., chem., biol., clay working and ceramics (B. S.).
Nevada.....	University of Nevada.	Reno.....	W. D. Gibbs, D. Sc.	New Brunswick..
New Hampshire.....	The New Hampshire College of Agriculture and Mechanic Arts.	Durham.....	W. H. S. Demarest, A. M., D. D., LL.D.	Clas. (A. B.), Lat. sci. (Litt. B.), general sci., agr., civil engin., mech. engin., elect. engin., chem., biol., clay working and ceramics (B. S.).
New Jersey.....	Rutgers Scientific School, The New Jersey State College for the Benefit of Agriculture and Mechanic Arts.			

¹ Four-year courses unless otherwise specified.

TABLE I.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.*

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate).	
				Degree courses 1	Preparatory and short courses.
New Mexico.....	Agricultural College of Agricultural and Mechanic Arts.	V. W. E. Garrison, Ph. D.	W. E. Garrison, Ph. D.	Agr., mech. engin., civil engin., elect. engin., household econ., commerce, general sci. (B. S.).	See, indu. agr., indu. mech., indu. dom. sci., indu. business, prep. (4 yrs. each), Eng. and Engl.-Spanish sten. (1 yr. each), farmers' week.
New York.....	Cornell University.....	Ithaca.....	J. G. Schurman, D. Sc., LL. D.	Arts (A. B.), civil engin. (C. E.), mech. engin. (M. E.), elect. engin. (E. E.), arch. (B. Arch.), agr. (B. S. A.), vet. med. (3 yrs., D. V. M.), law (3 yrs., LL. B.). Agr. (B. S.), mech. engin., civil engin., elect. engin., textile sci. and art (B. E.), chem., dyeing (B. S.).	Mech. arts, textile art (2 yrs.), normal courses in agr. and nature study (1 and 2 yrs.), agr. (1 yr.), agr. and dairying (7 weeks, winter), May school for agr. teachers (1 month), corn culture (1 week, January), farm drainage (1 week), agr. hist.
North Carolina.....	The North Carolina College of Agriculture and Mechanic Arts.	West Raleigh.....	D. H. Hill, A. M., LL. D.	.....	Prep. (2 yrs.), agr. (2 yrs.), summer school (4 weeks).
North Dakota.....	The Agricultural and Mechanical College for the Colored Race. North Dakota Agricultural College.	Greensboro.....	J. B. Dudley, A. M., LL. D.	Agr. (B. Agr.), mech. (B. S.).....	Farm busb., power mach. (3 yrs. each) phar., home econ. (3 yrs.), high school agr., commerce, dom. sci., mech. arts and manual training, general sci. (3 yrs.) nature study, el. agr., dom. sci. and manual training for rural teachers (3 yrs.) agr., steam engin., (winter, 10 weeks each), traction engin. (summer, 4 weeks), summer school for teachers, including agr., nature study, and home econ. (4 weeks).
Ohio.....	Ohio State University.	Columbus.....	W. O. Thompson, A. M., D. D., LL. D.	.....	Agr. (B. S. Agr.) ed., hort., forestry, dom. sci., chem. engin., indu. arts, manual training, phar. (B. S.), arts, philos. and sci. (B. A.), archi (C. E. in Arch.), civil engin. (C. E.), ceramic engin. (Cer. E.), min. engin. (E. M.), elect. engin. (M. E. in E. E.), mech. engin. (M. E.), vet. med. (3 yrs., D. V. M.), law (3 yrs., LL. B.).

Oklahoma.....	Agricultural and Mechanical College.	J. H. Connell, M. S.	Stillwater.	Agr., animal husb., hort., agron., dairy husb., mech. engin., archi. and civil engin., elect. engin., sci., and lit., dom. sci. and art, normal (B. S.).	See, agr. and dom. sci. (2 yrs.), business agr. (1 yr.), agr. and dairy (winter, 10 weeks), drying (winter, 4 weeks), cotton grading (3 weeks), ice-cream making (2 weeks), milk and cream testing (1 week), summer normal for teachers of agr. (6 weeks), reading course in agr. for teachers (2 yrs.), farmers' week, agr. and dom. sci. (1 week).
Colored Agricultural and Normal University.	Langston.	I. E. Page, A. M.	Clas. (B. A.), sci. (B. S.), normal (B. S. D.), agr. (B. S. Agr.), elect. engin., mech. engin., archi. engin. (B. M. E.).	Agron., hort., animal husb., agr. chem., dairy husb., ent., bac't., vet. sci., poultry husb., mech. engin., elect. engin., civil engin., mining engin., dom. sci. and art, forestry, phar., commerce (B. S.).	Normal, el. with required agr. (4 yrs. each), prep. (3 yrs.), agr. (3 yrs.), agr. (1 yr.), trade courses in carpentry, mach., blacksm., steam engin. (3 yrs.).
Oregon.....	Corvallis.	W. J. Kerr, D. Sc.	The Pennsylva-nia State College.	Classical, mod. lang. and lit., history and pol. lit., sci., philos. and ed., prep. to law, agr. I chem., agron., animal husb., dairy, home econ., hot., landscape gard., forestry, home econ., biol., chem., civil engin., elect. engin., electrochem. engin., industr. chem., flour mill engin., industr. engin., math., archi. engin., mech. engin., mining engin., metal. engin., phys., prep. to med., sanitary engin., ind. arts., highway engin., ry. mech. engin., min. geol., manual training (B. S.).	Normal nature study, el. agr., sewing, bot. zool., (18 weeks each), dom. sci., school gardening (1 yr. each).
Pennsylvania.....	University of Porto Rico.	E. E. Sparks, Ph. D., LL. D.	San Juan.	Agr., animal husb., bot., chem., dom. sci., hort., phys., zool., ed., manual training (4-yr. courses, but no degrees conferred.)	Normal nature study, el. agr., sewing, bot. zool., (18 weeks each), dom. sci., school gardening (1 yr. each).
Porto Rico.....	Rhode Island College..	E. G. Dexter, A. M., Ph. D.	Kingston.	Agr., mech. engin., civil engin., chem. engin., elect. engin., teachers' course in applied sci., home econ. (B. S.).	Agr. (2 yrs.), mech. arts (2 yrs.), dom. sci. (2 yrs.), poultry school (winter, 6 weeks), summer school for teachers et al., in el. agr., "nature study," schoolgard., and dom. sci., "farmers" week.
Rhode Island.....	The Clemson Agricultural College of South Carolina.	W. M. Riggs, E. M. E., LL. D.	Clemson College...	Agr., agr. and chem., agr. and animal husb., mech. and elect. engin., civil engin., chem., and geol., textile indus. (B. S.).	Textile indus. (2 yrs.), prop. (1 yr.), cotton grading (4 weeks), farmers' course (winter, 4 weeks), 2-yr. work course in agr.
South Carolina.....	The Colored Normal, Industrial, Agricultural, and Mechanical College of South Carolina.	R. S. Wilkinson, Ph. D.	Orangeburg.....	Collegeiate (B. A.), mech. (B. S.), agr. (B. Agr.).	Prop. (3 yrs.), normal (4 yrs., L. I.), model school. indus., music, art.

¹ Four-year courses unless otherwise specified.

TABLE I.—*Institutions established under the land-grant act of July 2, 1862, and their courses of study—Continued.*

[All of the institutions in this list, except those marked with an asterisk (*), maintain courses of instruction in agriculture.]

State or Territory.	Name of institution.	Location.	President.	Collegiate courses of study (undergraduate.)	
				Degree courses. ¹	Preparatory and short courses.
South Dakota	South Dakota State College of Agriculture and Mechanic Arts.	Brookings	R. L. Slagle, A. M., Ph. D.	Agr., home econ., general sci., mech. engin., elect. engin., civil engin., pharm. (B. S.), pharm. (2 yrs., Ph. G.).	Prep., coml. sci., sec. agr. and home econ. (3 yrs.), 2 yrs. normal in home econ., music (2 courses, 3 yrs. each), steam engin. (5 months), creamery (3 months), agr. and home econ. (12 weeks), agr., dairying (winter, 2 weeks), summer session for teachers, including agr., home econ., etc. (3 weeks), corresp. courses in agr., nature study, and home econ., art, secretarial (1 yr.), El. agr. for negroes (4 yrs.), agr., prep. med. (2 yrs. each), agron., hort., animal husb., dairy husb., poultry husb., beekeeping (2 weeks each), summer school of agr. (10 weeks, in succession 2 yrs., summer), summer school of agr. for teachers (6 weeks).
Tennessee	University of Tennessee.	Knoxville	Brown Ayres, Ph. D. LL. D., D. C. L.	Lit. (B. A.), agr., home econ., sci., civil engin., mech. engin., elect. engin., mining engin., metal engin., chem. engin. (B. S.), med. (M. D.), education (2 yrs. and B. S. in Ed.), dental surgery (3 yrs.; D. D. S.), law (2 yrs., LL. B.), pharm. (Ph. C.). Agr., elect. engin., mech. engin., civil engin., archt., archt. engin., chem. engin., textile engin. (B. S.).	Agri. (2 yrs.), textile engin. (2 yrs.), summer school (6 weeks), including summer normal, practical farmers' course (6 weeks), corresp. course in agr., school of cotton classing (6 weeks) and indus., including agr., mech. arts, and dom. sci. (4 yrs.), mech. arts (3 yrs.), agr. and hort. (2 yrs.), dairy (2 yrs., summer school).
Texas	Agricultural and Mechanical College of Texas.	College Station	R. T. Milner	College Station	Manual training in mech. arts (4 yrs.), manual training in home econ. (4 yrs.), high-school commerce (4 yrs.), prep. (3 yrs.), commerce (2 yrs., winter), agr., domestic sci. and mech. arts (8 weeks), forestry (12 weeks), summer school (6 weeks), farmers' round-up and housekeepers' comi. (2 weeks), music.
Utah	Prairie View Normal and Industrial College.	Prairie View	E. L. Blackshear ² .	J. A. Widtsoe, Ph. D.	Agron., hort., animal husb. and dairying, home econ., agr. engin., agr. chem., commerce, general sci. (B. S.).
Vermont	Agricultural College of Utah	Logan		G. P. Benton, LL. D. D. D.	Clas. (B. A.), lit. sci. (Ph. B.), civil and sanitary engin., elect. engin., mech. engin., chem., agr., commerce and econ., education, home econ. (B. S.), med. (M. D.).
	University of Vermont and State Agricultural College.	Burlington			Agri. (winter, 5 weeks), farm dairying (4 weeks), summer school for teachers, including agr. and dom. sci. (6 weeks), home econ. (2 weeks each), farmers' week.

Virginia.....	The Virginia Agricultural and Mechanical College and Polytechnic Institute. The Hampton Normal and Agricultural Institute.	P. B. Barringer, M. D., LL. D.	Agr., hort., applied chem., civil engin., mech. engin., elect. engin., mining engin., metal. and metallurgy, applied geol., applied biology (B. S.).	Agr., apprentice course (1 yr.), farmers' winter course (1 month).
Washington.....	State College of Washington.	H. B. Frissell, 2 D. D., LL. D.	Academic (4 yrs.), trade (3 yrs.), pract. agr. (3 yrs.), Graduate: Agr. (1 yr.), dom. sci. and art (2 yrs.), matrons' course (2 yrs.), normal (2 yrs.), business (2 yrs.), library methods (2 yrs.), summer session for teachers in agr., dom. sci., etc. (4 weeks). Gold and metal mining (2 yrs. each), el. sci. (3 yrs.), at (2 yrs.) $\frac{1}{2}$ yr. course for forest rangers, arts and crafts (1 yr.), bookkeeping, sten. (1 yr. each) agr., bookkeeping, sten. (20 weeks), mining (8 weeks), summer science school for teachers (6 weeks), hort.	
West Virginia.....	West Virginia University.	E. A. Bryan, A. M., LL. D.	Math., civil engin., phys., hydro-elect. engin., domestic econ., phar., chem., bot., zool., econ., biol., agron., animal husb. and dairyng, hort., forestry, vet. sci., econ. sci. and hist., elect. engin., mech. engin., mining engin., (B. S., B. A.) geol., Engl. lang. and lit., modern lang., Latin, education arch., (B. A.), vet. sci. (3 yrs., D. V. S.), phar. (2 yrs., Ph. G.), music (3 yrs., B. Mus.). General culture (B. A.; B. S.), mech. and elect. engin. (B. S., M. E.), civil engin. (B. S., C. E.), mining engin. (B. S., E. M.), agr. (B. S., Agr.), commerce (B. S., Com.), law (3 yrs., L. L. B.).	Sec. agr. (3 yrs., diploma), dom. sci. for teachers (2 yrs.), commerce (2 yrs., agr., dom. sci. (4 yrs., 6 months each), prep. (4 yrs.), agr., hort., animal husb., dairying, poultry culture (12 weeks), el. agr. and nature study for teachers (summer, 6 weeks), agr. (farmers' course) $2\frac{1}{2}$ weeks, agr., short course (winter, 12 weeks for 2 yrs.), music (3 and 4 yrs., cert.), art (4 yrs., diploma). Normal, agr., acad., mech., printing (4 yrs.), sewing, dressmaking, com. I, cooking, milking (2 yrs.), agr. (2 yrs., 2 winter courses, 14 weeks each), dairy school (winter, 12 weeks), creamery (summer, 10 weeks), farmers' course (10 days, winter), summer school, including agr. and home econ. (6 weeks), spec. cheese and creamery, housekeepers' boys' com. and seed grain (1 week), housekeepers' conf., correspn.
Wisconsin.....	University of Wisconsin.	T. E. Hodges, A. M., D. Sc.	Byrd Prillerman, A.M.	Prep., commerce (4 yrs.), animal husb., agr., (8 weeks, winter, summer school for teachers (6 weeks), music, correspn. courses.
Wyoming.....	University of Wyoming.	C. O. Merica, A. M., LL. D.		

¹ Four-year courses unless otherwise specified.² Principal.

TABLE 2.—General statistics of land-

State or Territory.	Date of establish- ment of institu- tion.	Date of estab- lish- ment of agri- cultural course.	Faculty.					
			College of agriculture and mechanic arts.					
			Interior instruction.				Agricultural extension department workers.	
			Prepara- tory classes. ¹	Secon- dary schools of agri- culture.	Collegiate and special classes.	Total. ²	Full time.	Part time.
1 Alabama.....	1872	1872	.....	.....	61	61	1	.....
2 Arizona.....	1891	1891	11	.....	20	23	1	6
3 Arkansas.....	1872	1872	5	.....	24	29	2	13
4 California.....	1868	1868	.....	26	90	108	2	25
5 Colorado.....	1877	1878	.....	30	55	57	1	32
6 Connecticut.....	1881	1881	9	.....	23	23	.....	1
7 Delaware.....	1870	1870	.....	.....	4	4	.....	2
8 Florida.....	1884	1884	.....	15	.....	15	2	8
9 Georgia.....	1872	1872	.....	.....	.....	.....	5	9
10 Hawaii.....	1907	1907	.....	.....	17	17	.....	.....
11 Idaho.....	1892	1892	8	2	49	59	4	.....
12 Illinois.....	1867	1868	.....	.....	50	50	2	1
13 Indiana.....	1874	1874	.....	.....	158	158	4	.....
14 Iowa.....	1869	1869	.....	.....	139	139	16	15
15 Kansas.....	1874	1874	15	.....	116	131	11	25
16 Kentucky.....	1865	1880	6	.....	20	26	1	.....
17 Louisiana.....	1877	1887	.....	14	56	61	2	5
18 Maine.....	1865	1868	.....	6	79	79	1	9
19 Maryland.....	1859	1859	7	.....	23	30	1	22
20 Massachusetts (Amherst).....	1867	1867	.....	.....	42	42	3	22
21 Massachusetts (Boston).....	1865	.....	.....	.....	230	230	.....	.....
22 Michigan.....	1855	1855	.....	.....	115	115	4	10
23 Minnesota.....	1869	1869	.....	44	35	79	10	2
24 Mississippi.....	1880	1880	.....	.....	55	55	4	20
25 Missouri (Columbia) ⁵	1870	1870	.....	.....	68	68	2	.....
26 Montana.....	1893	1893	13	14	39	42	1	16
27 Nebraska.....	1869	1869	.....	37	35	46	1	13
28 Nevada.....	1873	1888	12	2	33	39	.....	.....
29 New Hampshire.....	1866	1866	.....	18	38	38	.....	.....
30 New Jersey.....	1864	1865	12	.....	47	58	.....	.....
31 New Mexico.....	1889	1890	3	.....	40	43	.....	.....
32 New York.....	1865	1865	(?)	(?)	440	440	.....	.....
33 North Carolina.....	1889	1889	.....	.....	48	48	1	5
34 North Dakota.....	1890	1890	17	61	55	80	2	17
35 Ohio.....	1870	1873	.....	.....	177	177	16	16
36 Oklahoma.....	1891	1892	7	43	48	98	4	7
37 Oregon.....	1868	1888	.....	.....	.....	891	.....	.....
38 Pennsylvania.....	1855	1859	.....	.....	165	165	2	.....
39 Porto Rico.....	1903	1904	11	.....	21	32	.....	.....
40 Rhode Island.....	1888	1890	.....	10	29	29	2	1
41 South Carolina.....	1889	1893	2	.....	53	55	3	.....
42 South Dakota.....	1881	1884	5	4	47	56	.....	6
43 Tennessee.....	1794	1869	8	.....	64	72	.....	6
44 Texas.....	1871	1871	9	.....	68	77	.....	6
45 Utah.....	1888	1889	9	.....	11	20	3	14
46 Vermont.....	1865	1885	.....	.....	45	45	.....	.....
47 Virginia.....	1872	1872	.....	.....	61	61	.....	.....
48 Washington.....	1892	1892	10	5	86	91	3	21
49 West Virginia.....	1867	1867	.....	.....	16	16	1	4
50 Wisconsin.....	1848	1866	.....	68	140	140	.....	68
51 Wyoming.....	1887	1891	.....	.....	8	8	.....	.....
	Total.....	.....	174	394	3,343	3,726	41	406

¹ Including schools of agriculture of high-school grade under the control of the institution.² Counting none twice.³ Including substations.⁴ Including college of law.⁵ Including data for School of Mines at Rolla.

grant colleges for white students, 1911.

Faculty—Continued.		Library.		Number of acres allotted to State under act of 1862.	Number of acres land grant still unsold.	Number of acres in farms and grounds.	Rate of interest on land-grant fund of 1862.
College of agriculture and mechanic arts—Continued.	Experiment station officers. ³	Total for entire institution, counting none twice.	Number of volumes.				
31	67	67	23,974	3,000	240,000	325	1
12	35	42	16,500	16,000	.....	545	2
18	49	111	15,420	5,621	150,000	160	3
60	134	448	244,000	65,000	150,000	1,599	4
28	65	66	48,000	50,000	90,000	40,000	5
13	30	30	12,000	1,000	180,000	679	6
14	10	24	18,000	2,500	90,000	227	7
17	35	52	12,500	4,000	90,000	512	8
8	14	14	36,825	5,000	270,000	987	9
	17	17	8,650	8,000	.....	90	10
26	18	61	23,861	3,000	90,000	70,142	11
70	77	615	188,186	23,191	480,000	715	12
51	199	199	29,867	35,000	390,000	280	13
39	182	182	32,500	40,000	204,000	1,175	14
60	195	195	36,973	18,000	82,313	7,686	15
34	50	82	7,533	8,500	330,000	247	16
23	87	90	33,000	10,000	210,000	724	17
23	88	498	43,811	11,000	210,000	473	18
15	48	48	6,000	5,000	210,000	280	19
31	70	70	34,448	.....	360,000	485	20
	230	230	89,710	19,470	.....	18	21
29	123	123	34,218	7,203	235,673	684	22
56	134	.....	150,000	20,000	94,000	1,557	23
27	66	66	25,428	11,213	207,920	2,000	24
56	70	259	114,134	20,000	277,016	693	25
18	53	53	11,300	6,500	90,000	617,863	26
34	50	333	93,678	3,500	90,000	3,203	27
15	41	55	19,500	11,500	90,000	2,000	28
17	40	40	28,000	9,000	150,000	400	29
16	69	69	64,521	5,000	210,000	146	30
21	46	46	13,676	5,000	.....	489	31
45	440	653	395,209	60,000	989,920	1,098	32
18	75	75	10,028	5,230	270,000	485	33
44	94	94	22,800	1,100	130,000	943	34
58	209	267	106,390	10,000	630,000	439	35
17	119	119	14,506	10,000	250,000	1,000	36
39	108	139	15,563	15,000	90,000	237	37
53	179	179	43,510	30,000	780,000	400	38
	32	44	3,729	1,770	.....	270	39
14	45	45	22,031	5,000	120,000	169	40
19	70	70	16,488	9,000	180,000	1,544	41
20	56	56	12,500	2,000	160,000	560	42
21	80	153	34,411	18,689	300,000	272	43
24	92	92	20,000	15,000	180,000	2,416	44
26	45	70	19,470	20,612	200,000	124	45
18	56	104	83,040	34,520	150,000	175	46
26	79	79	12,400	33,000	300,000	408	47
32	101	121	28,156	5,500	90,000	486	48
17	36	95	43,000	2,500	150,000	160	49
71	140	517	169,602	47,000	240,000	1,021	50
13	23	45	30,000	.....	90,000	514	51
1,437	4,471	6,802	2,619,046	758,119	10,570,842	979,872	31,923

⁶ Including land grants other than that allotted July 2, 1862.

⁷ Instruction in these classes given by the college of arts and sciences.

⁸ Including professors in secondary schools of agriculture and in collegiate and special classes.

⁹ 835 acres additional yet to be selected.

¹⁰ Some of these teach both preparatory and collegiate classes.

TABLE 3.—*Graduates and students, by classes, at land-grant colleges for white students in 1911.*

State or Territory	Graduates.			College of agriculture and mechanic arts.										Other departments, week away from college, ³	Total, ⁴			
	In 1910-11.			Interior courses.					Exterior courses.									
	Agricultural classes	Mechanic arts courses.	All other courses.	Total number since organization.	Preparatory.	Secondary schools of agriculture.	Post-graduate.	One to two year courses of college grade.	Short courses.	Total ²	Correspondence.	Farmers' week at college.	Extension courses away from college, ³					
Alabama (Auburn).....	22	54	48	124	1,388	80	90	2	26	737	1,000	6,233	14	1,737				
Arkansas (Fayetteville).....	2	4	8	87	80	828	94	4	31	101	132	179	5	1,441				
California.....	22	146	80	240	6,591	81	1,076	50	20	1,320	135	4,000	156	4,236				
Colorado.....	16	20	272	41	445	291	143	23	224	938	114	1,213	112	9,857				
Connecticut.....	4	33	4	38	318	40	143	2	4	345	33	33	33	2,377				
Delaware (Newark).....	2	2	33	4	512	29	78	6	4	88	33	337	140	345				
Florida (Gainesville).....	2	5	22	29	104	104	254	3	28	339	30,000	200	1,480	153				
Georgia (Athens).....	6	14	20	538	145	1	145	1	32	146	146	337	153	645				
Hawaii.....	7	17	1	22	47	336	118	32	409	10	527	7	795	1,322				
Idaho.....	49	221	10	215	495	6,864	1,531	17	98	1,646	1,000	3,000	3,000	3,677				
Illinois.....	40	221	12	69	330	3,965	1,539	162	75	1,885	1,307	4,600	1,307	9,825				
Indiana.....	17	102	12	96	227	2,665	1,474	15	149	2,292	1,595	13,214	7	7,962				
Iowa.....	47	59	33	23	182	1,890	1,588	34	474	2,407	248	1,680	75	16,116				
Kansas.....	24	52	47	77	1,886	125	1,151	52	29	428	600	600	375	3,735				
Kentucky (Lexington).....	6	3	64	73	688	80	506	13	231	737	131	609	1,383	1,372				
Louisiana (Baton Rouge).....	6	80	50	139	1,584	45	517	14	21	64	661	297	400	257				
Maine.....	9	3	9	17	339	61	109	6	34	339	339	250	1	5,555				
Maryland (College Park).....	5	43	43	907	907	4,577	4,577	15	17	114	483	830	1,090	500				
Massachusetts (Amherst).....	35	52	25	231	231	4,577	1,470	36	1,470	1,506	1,506	1,506	239	2,090				
Massachusetts (Boston).....	28	61	9	472	570	8,482	1,121	10	431	321	1,570	1,570	1,570	1,570				
Michigan.....	20	26	20	66	703	320	755	12	203	57	1,942	1,942	1,942	4,062				
Mississippi (Agricultural College).....	33	378	4,135	378	4,135	320	375	28	299	1,087	250	305	305	6,024				
Missouri (Columbia).....	33	33	33	33	33	33	33	33	33	1,300	3,050	692	2,449	7,491				

Montana.....	5	8	29	143	81	34	247	6	113	305	112	112	35
Nebraska.....	7	276	350	4,117	395	188	6	18	207	632	1,500	1,970	4,022
Nevada.....	1	18	22	494	99	188	6	18	246	311	238	238	311
New Hampshire.....	12	12	30	443	207	59	59	59	233	512	614	614	512
New Jersey.....	17	31	57	801	181	83	83	83	233	614	614	614	614
New Mexico.....	1	3	11	117	154	346	4	2	222	222	222	222	222
New York.....	233	436	748	12,122	525	477	119	13	26,000	2,500	10,000	2,498	44,124
North Carolina (West)	33	8	44	569	290	170	397	13	101	87	630	300	500
Raleigh.....	7	24	129	290	215	3	31	1	104	289	1,701	126	1,430
North Dakota.....	27	226	355	739	334	213	1,363	8	1,17	183	2,476	870	2,100
Ohio.....	3	29	72	334	475	199	981	186	621	155	60	17,000	17,000
Oklahoma (Stillwater).....	18	34	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080	1,080
Oregon.....	23	63	14	228	228	228	756	756	649	157	1,776	628	3,579
Pennsylvania.....	39	157	7	25	228	1,700	1,381	36	124	121	1,662	460	2,298
Rhode Island.....	4	7	4	15	180	150	150	3	25	28	403	500	400
Puerto Rico.....	43	5	87	769	80	603	603	20	20	20	250	125	375
Rhode Island.....	9	10	32	457	101	166	188	5	76	703	703	20	2,723
South Carolina.....	19	79	100	97	866	127	127	127	57	141	141	141	141
South Dakota.....	2	2	97	106	106	68	5	114	25	1,158	802	1,783	98
Tennessee.....	38	9	17	64	274	189	159	159	187	535	89	965	965
Texas.....	9	27	8	105	429	210	1	1	36	246	425	18	1,158
Utah.....	8	51	9	68	932	34	426	1	31	502	502	6,500	6,500
Vermont.....	14	31	9	48	102	599	138	9	207	12	721	1,454	1,454
Virginia.....	6	7	60	73	1,355	9	1,093	1,093	71	189	189	1,701	1,701
Washington.....	53	120	13	422	608	8	233	233	77	100	2,100	1,853	1,853
West Virginia.....	1	2	25	28	221	17	17	17	17	17	17	8,500	8,500
Wisconsin.....												209	209
Wyoming.....												286	286
Total.....	860	2,265	228	3,964	7,317	95,512	3,438	3,604	27,616	690	1,504	7,487	249,855
												2,042	2,042
												45,871	45,871
												61,709	61,709
												26,667	26,667
												81,082	81,082
												35,191	35,191

¹ Including schools of agriculture or high-school grade under the control of the institution.

² Total countings done twice

Total, Cottling Nolle twice.
Not including farmers' institutes

Not Welding Farmers' Institute

This total includes not only those regularly enrolled in the institution, but in some cases many persons who have received limited instruction by correspondence or otherwise from the extension department of the college.

TABLE 4.—*Students, by courses, at land-grant colleges for white students in 1911.*

State or Territory.	Four-year.					Shorter.				
	Agriculture.	Horticulture.	Veterinary science.	Total, ¹	Household economy.	Engineering.	Agriculture.	Horticulture.	Veterinary science.	Teachers' course in agriculture.
										One to three years.
Alabama.....	60	30	22	50	162	277	20	20	27	78
Arizona.....	5	5	5	5	42	42	26	20	4	380
Arkansas.....	30	.....	.....	30	207	207	20	20	67	1,128
California.....	233	.....	.....	233	718	718	47	47	63	349
Colorado.....	14	6	3	34	57	49	85	85	14	130
Connecticut.....	118	.....	.....	118	118	108	4	4	114	13
Delaware.....	16	.....	.....	16	14	14	47	47	12	157
Florida.....	14	.....	.....	14	70	37	62	62	14	130
Georgia.....	66	4	2	62	2	8	5	5	12	142
Hawaii.....	29	19	.....	48	90	48	41	41	40	1,479
Idaho.....	630	.....	.....	630	175	1,041	46	46	20	721
Illinois.....	3,164	18	100	182	1,212	4,149	19	19	160	340
Iowa.....	352	34	61	486	149	362	320	320	20	480
Kansas.....	370	41	.....	472	515	250	40	40	9	259
Kentucky.....	83	.....	.....	83	14	119	50	50	75	372
Louisiana.....	56	.....	.....	56	56	301	6	6	1	245
Maine.....	58	37	.....	95	95	26	64	64	74	180
Maryland.....	16	10	.....	26	26	114	114	114	114	375
Massachusetts (Boston).....	419	.....	.....	419	.....	892	40	40	123	343
Michigan.....	382	64	5	451	216	440	281	281	18	801
Minnesota.....	107	113	.....	220	69	537	203	203	18	1,075
Mississippi.....	307	.....	.....	307	257	356	19	19	29	437
Missouri.....	356	.....	.....	356	585	39	38	38	27	758
Montana.....	39	5	46	39	30	412	97	97	89	128
Nebraska.....	99	.....	.....	130	25	412	513	513	27	215
Nevada.....	25	.....	.....	49	49	49	80	80	24	260
New Hampshire.....	49	.....	.....	39	106	119	59	59	14	112
New Jersey.....	39	.....	.....	39	14	5	5	5	1,631	700
New Mexico.....	14	.....	.....	761	761	477	159	159	477	433
New York.....	761	.....	.....	126	126	126	35	35	39	1,108
North Carolina.....	126	.....	.....	45	45	45	191	191	24	612
North Dakota.....	40	5	56	82	36	171	98	98	112	200
Oklahoma.....	265	20	56	341	55	156	707	707	182	18
Ohio.....	76	.....	.....	76	341	191	757	757	170	612

	171	23	194	106	222	405	122	168	19	10	687
	2 654		654	40	237	237		8			900
Oregon.....	25		25	10	10	10		41	10	19	131
Pennsylvania.....	26		26	19	91	10		3	13	6	141
Porto Rico.....	261		261	307	22						680
Rhode Island.....	47		47	34	45	141					131
South Carolina.....	60		60	4	125	52					1,032
South Dakota.....	403		406	73	56.5	25					220
Tennessee.....	123		148	73	239	18	12				160
Texas.....	60		60	6	99	36					436
Utah.....	73		84	3	307	5					540
Vermont.....	68	10	178	103	172	30					864
Virginia.....	25	3	28	100	80	12	45				96
Washington.....	369		369	100	763	71					
West Virginia.....	11		11	12	20						
Wisconsin.....											
Wyoming.....											
Total.....	7,796	449	296	8,754	2,258	15,555	6,775	565	111	418	958
											20,117

¹ Counting none twice.² Including students in horticulture, forestry, and veterinary science.³ Including students in horticulture, 23 in dairy ing, and 54 in animal husbandry.⁴ Including students in horticulture, 23 in dairy ing, and 54 in animal husbandry, and 29 in dairy ing.⁶ Including 19 students in poultry husbandry.⁷ Including 8 students in dairy ing.⁸ Three-year course.⁹ Including 35 students taking regular college work but not including summer-school students.¹⁰ Including 28 students in poultry husbandry.

TABLE 5.—General statistics and students, by classes, at land-grant colleges for colored students in 1911.

State or Territory.	Date of establishment of institution.	Faculty.			Graduates.			Library.			College of agriculture and mechanie arts.			Students by classes.		
		College of agriculture and mechanie arts.			In 1910-11 (number).			Number of volumes.			Number of acres in farm and grounds.			Other de- partments.		
		Pre- paratory classes.	Collegiate and special courses.	Total.	Other de- partments.	Total.	In 1910-11 (num- ber).	Pre- paratory.	Colle- giate.	Post- grad- uate.	Short or sum- mer school.	Sum- mer school.	Total.	Total.	Total.	
Alabama (Normal).....	1875	1882	4	7	10	20	2	1,384	9,000	800	182	210	91	6	32	333
Arkansas (Pine Bluff).....	1875	1892	10	8	10	10	10	225	3,600	1,500	20	320	60	6	320	320
Delaware (Dover).....	1892	1892	8	9	14	13	1	146	5,000	600	97	180	86	11	180	180
Florida (Tallahassee).....	1887	1890	8	10	16	16	16	226	700	400	250	303	11	100	414	414
Georgia (Savannah).....	1890	1890	12	4	16	16	16	262	1,500	2,000	325	420	16	133	420	420
Kentucky (Frankfort).....	1887	1892	3	13	16	20	25	502	2,750	5,396	104	230	97	9	230	230
Louisiana (New Orleans).....	1880	1890	9	11	11	20	12	126	1,200	1,000	118	140	425	9	140	140
Maryland (Princess Anne).....	1871	1871	13	7	13	8	14	336	2,700	2,000	850	1,400	101	101	1,400	1,400
Mississippi (Arlorn).....	1866	1866	6	7	16	15	26	532	4,068	4,068	48	388	16	16	388	388
Missouri (Jefferson City).....	1866	1866	16	16	26	26	26	532	4,068	4,068	48	388	14	14	388	388
North Carolina (Greensboro).....	1891	1891	13	16	16	16	8	115	1,545	23,000	128	163	105	91	359	359
Oklahoma (Langston).....	1897	1899	3	8	11	11	6	21	1,646	3,262	320	497	7	97	553	553
South Carolina (Orangeburg).....	1896	1896	11	8	19	19	1	534	200	150	130	584	130	97	169	169
Texas (Prairie View).....	1868	1890	20	20	40	40	139	895	2,500	1,490	875	1,490	7	7	584	584
Virginia (Hampton).....	1891	1892	11	19	130	130	1	1,631	28,476	11,000	1,047	1,195	31	7	960	960
West Virginia (Institute).....	1891	1892	10	14	21	21	21	272	600	1,200	77	88	136	25	102	102
Total.....	.....	157	245	374	86	260	7,337	66,435	50,608	5,272	6,273	864	62	7	699	7,847
																8,138

¹ Total counting none twice.

TABLE 6.—*Students, by courses, at land-grant colleges for colored students in 1911.*

State or Territory.	Agriculture.	Teachers in courses in agriculture.	Summers.	One to four years.	Carpentry.	Machinerey - shop work.	Shoemaking.	Broom making.	Wheelwrighting.	Bricklaying.	Painting.	Plastering.	Tallowing.	Harmess making.	Sewing.	Cooking.	Laundring.	Nursing.	Military.	Militia.	Military tactics.		
Alabama (Normal).....	110	15	7	7	25	4	7	7	25	4	7	7	22	25	61	14	30	8	10	102	40	702	
Arkansas (Pine Bluff).....	320	22	8	6	35	13	7	44	27	14	15	89	18	12	21	11	31	30	30	121	18	46	
Delaware (Dover).....	11	14	76	14	48	27	16	33	15	15	89	18	12	21	11	31	30	30	138	65	14	118	
Florida (Tallahassee).....	189	5	17	16	16	17	16	84	84	15	89	18	12	21	11	30	30	30	120	120	96	355	
Georgia (Savannah).....	362	48	48	48	38	38	38	38	38	38	38	38	38	38	38	38	38	38	120	120	96	94	
Kentucky (Frankfort).....	316	36	6	6	100	15	15	60	20	15	10	19	30	6	9	1	35	15	138	138	138	94	
Louisiana (New Orleans).....	152	6	156	156	115	115	115	40	23	6	5	5	11	26	26	26	26	26	79	44	5	53	
Maryland (Princess Anne).....	94	28	56	56	29	18	18	18	11	11	47	11	11	43	43	43	43	43	96	46	140	6	
Mississippi (Alcorn).....	145	48	15	15	14	39	38	38	32	32	40	8	8	38	38	38	38	38	282	180	305	268	
Missouri (Jefferson City).....	362	38	100	100	56	60	60	60	20	20	15	10	19	30	6	9	1	35	520	520	400	272	
North Carolina (Greensboro).....	155	260	56	56	12	21	5	12	13	13	9	14	7	15	15	15	15	15	199	80	108	316	
Oklahoma (Langston).....	12	5	56	56	21	21	21	21	13	13	13	13	13	13	13	13	13	13	14	108	89	3	
South Carolina (Orangeburg).....	27	132	791	791	167	458	166	26	110	110	241	143	120	23	253	214	2,422	1,772	1,013	85	164	2,292	
Texas (Prairie View).....	12	5	56	56	21	21	21	21	13	13	13	13	13	13	13	13	13	13	14	108	89	3	
Virginia (Hampton).....	12	5	56	56	21	21	21	21	13	13	13	13	13	13	13	13	13	13	14	108	89	3	
West Virginia (Institute).....	2,257	27	132	791	791	167	458	166	26	110	110	241	143	120	23	253	214	2,422	1,772	1,013	85	164	2,292

TABLE 7.—*Value of permanent funds and equipment of land-grant colleges, 1911.*

State or Territory.	Land-grant fund of 1862.	Other land-grant funds.	Other endowment funds.	Land grant of 1862 still unsold.	Farms and grounds owned by the institution.	Buildings.	Scientific apparatus, machinery, and furniture.	Library.	Live stock.	Total.
Alabama (Auburn).....	\$253,500.00	\$31,000.00	...	...	\$9,000.00	\$33,385.74	\$75,747.66	\$75,000.00	\$4,576.35	\$802,209.75
Alabama (Normal).....	\$20,371.50	10,500.00	...	...	25,000.00	90,000.00	4,500.00	1,000.00	166,871.50	166,871.50
Arizona.....	130,000.00	...	...	...	33,000.00	70,399.89	33,000.00	1,545.00	3,55,984.89	3,55,984.89
Arkansas (Fayetteville).....	722,233.15	154,712.27	3,651,945.08	\$11,818.27	60,000.00	350,000.00	165,000.00	41,000.00	5,000.00	716,000.00
California.....	134,600.17	...	...	125,000.00	225,000.00	28,000.00	18,000.00	3,500.00	109,500.00	14,038,830.55
Colorado.....	135,000.00	61,000.00	...	...	36,500.00	201,000.00	130,433.31	30,000.00	10,188.00	1,051,291.48
Connecticut.....	83,000.00	...	...	...	45,000.00	144,000.00	90,000.00	20,000.00	16,600.00	615,100.00
Delaware (Newark).....	65,850.00	...	...	...	9,000.00	26,000.00	1,500.00	25,000.00	16,200.00	396,200.00
Delaware (Dover).....	153,800.00	...	...	...	150,000.00	220,000.00	65,000.00	14,000.00	4,000.00	672,650.00
Florida (Gainesville).....	...	...	...	...	15,000.00	35,400.00	19,063.11	2,000.00	3,378.00	74,841.11
Florida (Tallahassee).....	242,202.17	...	...	...	500,000.00	550,000.00	40,836.21	55,000.00	10,010.00	1,398,048.38
Georgia (Athens).....	...	...	...	...	6,776.25	55,932.77	2,284.35	551.06	855.00	66,449.63
Hawaii.....	...	...	...	...	100,000.00	20,564.00	33,872.00	16,500.00	4,000.00	174,936.00
Idaho.....	365,491.69	406,821.64	...	...	701,420.00	416,700.00	104,688.19	30,125.00	8,685.00	1,091,706.52
Illinois.....	647,131.53	340,000.00	...	...	410,000.00	2,093,500.00	1,399,282.80	380,000.00	22,151.50	4,952,065.83
Indiana.....	...	...	...	...	120,000.00	1,025,060.00	290,000.00	55,000.00	16,000.00	1,846,136.00
Iowa.....	686,777.97	147,797.50	...	...	689,829.00	333,942.00	155,000.00	53,942.00	3,042,221.42	1,378,723.60
Kansas.....	480,442.74	259,500.00	...	...	480,000.00	217,788.00	61,942.00	34,104.00	1,761,913.24	1,761,913.24
Kentucky (Lexington).....	144,075.00	...	...	...	250,000.00	250,000.00	15,916.00	708,991.00	2,244,222.64	1,51,321.62
Kentucky (Frankfort).....	...	...	...	...	29,100.00	109,382.34	7,834.28	4,000.00	1,225.00	44,000.00
Louisiana (Baton Rouge).....	182,313.00	...	...	...	151,400.00	524,277.66	113,350.47	4,000.00	400.00	1,151,381.13
Louisiana (New Orleans).....	118,300.00	100,000.00	...	...	75,000.00	49,160.82	8,722.40	4,140.00	1,365.00	138,388.22
Maine.....	115,443.60	...	...	...	11,000.00	488,259.82	101,921.61	57,386.51	6,639.00	882,506.94
Maryland (College Park).....	219,000.00	142,000.00	...	...	30,000.00	340,000.00	20,000.00	70,000.00	8,500.00	565,723.60
Maryland (Princess Anne).....	...	...	...	...	4,500.00	4,700.00	4,700.00	4,700.00	3,20,150.00	32,150.00
Massachusetts (Amherst).....	...	...	...	...	67,636.24	221,504.25	56,679.35	17,632.00	1,761,913.24	1,761,913.24
Massachusetts (Boston).....	...	...	...	...	708,200.00	628,800.00	401,945.00	187,586.35	3,818,158.42	3,818,158.42
Michigan.....	989,989.99	1,891,627.07	...	...	76,000.00	74,400.00	866,375.00	160,000.00	70,000.00	35,000.00
Minnesota.....	570,747.59	936,827.29	1,448,790.00	1,448,790.00	1,834,900.00	3,921,000.00	3,921,000.00	475,000.00	40,000.00	9,026,373.99
Mississippi (Agricultural College).....	98,575.00	141,212.55	250.00	...	80,000.00	589,880.00	334,307.38	34,818.32	45,732.00	1,324,505.35
Missouri (Alcorn).....	96,265.12	31,000.00	...	...	10,500.00	120,000.00	16,000.00	3,500.00	4,600.00	4,643,471.00
Missouri (Columbia).....	349,881.19	222,000.00	...	...	684,958.23	60,000.00	534,236.77	1,225,147.47	408,918.95	3,083,176.31
Missouri (Jefferson City).....	...	...	...	...	1,891,627.07	1,891,627.07	125,000.00	125,000.00	6,000.00	176,176.00
Montana.....	4,324,754.74	...	...	...	159,208.00	74,000.00	279,500.00	99,500.00	20,000.00	8,750.00
Nebraska.....	527,153.19	212,360.49	...	...	22,421.00	97,500.00	97,500.00	197,050.00	2,691,784.68	2,691,784.68
Nevada.....	101,700.00	43,415.34	...	...	25,000.00	422,636.25	160,166.56	32,045.52	8,224.93	828,080.14
New Hampshire.....	80,000.00	...	...	...	31,000.00	351,000.00	75,000.00	31,000.00	1,444,000.00	1,444,000.00
New Jersey.....	16,000.00	701,028.57	...	...	675,000.00	675,000.00	675,000.00	1,087,028.57	6,000.00	1,087,028.57
New Mexico.....	...	...	...	...	107,900.00	89,827.91	89,827.91	38,667.95	3,357,389.62	3,357,389.62
New York.....	688,576.12	21,656.76	8,048,532.32	8,048,532.32	269,231.67	4,219,092.02	1,1	771,397.40	15,266,212.91	15,266,212.91

¹ Including value of buildings, live stock, scientific apparatus, machinery, etc.

² Included under Massachusetts Agricultural College.
³ Including School of Mines at Rolla.

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TABLE 8.—*Revenue of land-grant*

State or Territory.	Federal aid.			State aid.	
	Interest on land grant of 1862.	Interest on other land grants.	Appropri- ation acts of 1890 and 1907.	Interest on endow- ment or regular appropri- ation.	Appropri- ation for current expenses.
1 Alabama (Auburn).....	\$20,280.00	.....	\$24,628.50	\$1,160.00	\$40,000.00
2 Alabama (Normal).....	1,500.00	.....	20,371.50	.....	4,000.00
3 Arizona.....	3,900.00	.....	45,000.00	.....	35,500.00
4 Arkansas (Fayetteville).....	3,900.00	.....	32,727.27	.....	99,000.00
5 Arkansas (Pine Bluff).....	.....	.....	12,272.72	.....	9,000.00
6 California.....	46,602.24	\$9,846.50	45,000.00	47,733.00	682,908.66
7 Colorado.....	9,350.00	.....	45,000.00	.....	75,000.00
8 Connecticut.....	6,750.00	.....	45,000.00	.....	25,000.00
9 Delaware (Newark).....	4,980.00	.....	36,000.00	.....	5,000.00
10 Delaware (Dover).....	.....	.....	9,000.00	.....	.....
11 Florida (Gainesville).....	4,994.00	1,975.50	22,500.00	.....	20,000.00
12 Florida (Tallahassee).....	.....	.....	22,500.00	.....	5,000.00
13 Georgia (Athens).....	16,954.00	.....	30,000.00	.....	50,000.00
14 Georgia (Savannah).....	.....	.....	15,000.00	.....	8,000.00
15 Hawaii.....	.....	.....	45,000.00	.....	9,993.06
16 Idaho.....	22,591.03	36,846.68	50,000.00	.....	40,000.00
17 Illinois.....	32,467.68	.....	45,000.00	.....	525,000.00
18 Indiana.....	17,000.00	.....	45,000.00	.....	186,934.96
19 Iowa.....	35,742.79	.....	45,000.00	.....	251,541.21
20 Kansas.....	29,418.33	.....	45,000.00	.....	200,000.00
21 Kentucky (Lexington).....	8,644.50	.....	38,475.00	.....	85,937.50
22 Kentucky (Frankfort).....	.....	.....	6,525.00	.....	11,000.00
23 Louisiana (Baton Rouge).....	9,115.69	5,440.00	24,917.25	.....	3 100,000.00
24 Louisiana (New Orleans).....	.....	.....	20,082.75	.....	10,000.00
25 Maine.....	5,915.00	.....	45,000.00	.....	4 101,500.00
26 Maryland (College Park).....	5,797.18	.....	45,000.00	.....	16,000.00
27 Maryland (Princess Anne).....	.....	.....	9,000.00	.....	.....
28 Massachusetts (Amherst).....	7,300.00	.....	30,000.00	3,313.32	101,500.00
29 Massachusetts (Boston).....	5,306.68	.....	15,000.00	29,000.00	.....
30 Michigan.....	70,304.15	.....	45,000.00	.....	163,410.00
31 Minnesota.....	22,396.37	36,761.46	45,000.00	.....	693,231.72
32 Mississippi (Agricultural College).....	5,914.61	8,472.75	22,820.18	.....	142,671.54
33 Mississippi (Alcorn).....	6,814.50	5,777.77	22,179.82	.....	8,000.00
34 Missouri (Columbia) ⁵	17,994.00	13,320.00	42,187.50	33,247.00	449,500.00
35 Missouri (Jefferson City).....	.....	.....	2,812.50	.....	72,500.00
36 Montana.....	621,217.87	.....	45,000.00	.....	21,966.26
37 Nebraska.....	42,250.00	.....	45,000.00	.....	363,460.00
38 Nevada.....	4,580.20	3,949.23	45,000.00	.....	116,065.00
39 New Hampshire.....	4,800.00	.....	45,000.00	.....	3,000.00
40 New Jersey.....	5,800.00	.....	45,000.00	.....	32,836.34
41 New Mexico.....	.....	1,082.84	45,000.00	.....	17,036.10
42 New York.....	34,428.80	.....	45,000.00	.....	257,433.30
43 North Carolina (West Raleigh).....	7,500.00	.....	30,150.00	.....	75,000.00
44 North Carolina (Greensboro).....	.....	.....	14,800.00	.....	10,000.00
45 North Dakota.....	58,514.23	.....	45,000.00	.....	55,314.99
46 Ohio.....	31,450.59	7,717.62	45,000.00	.....	445,227.56
47 Oklahoma (Stillwater).....	.....	28,448.10	40,500.00	.....	85,927.73
48 Oklahoma (Langston).....	.....	.....	4,500.00	.....	41,200.00
49 Oregon.....	11,032.98	.....	45,000.00	.....	65,000.00
50 Pennsylvania.....	30,000.00	1,020.00	45,000.00	.....	265,499.88
51 Porto Rico.....	.....	.....	45,000.00	.....	70,300.84
52 Rhode Island.....	2,500.00	.....	45,000.00	.....	25,000.00
53 South Carolina (Clemson College).....	5,754.00	.....	22,500.00	182,775.99	.....
54 South Carolina (Orangeburg).....	5,754.00	.....	22,499.55	.....	5,000.00
55 South Dakota.....	.....	29,856.59	45,000.00	.....	48,793.76
56 Tennessee.....	23,960.00	250.00	45,000.00	.....	41,745.15
57 Texas (College Station).....	8,233.62	172,350.00	33,750.00	.....	79,900.00
58 Texas (Prairie View).....	.....	.....	12,500.00	.....	33,000.00
59 Utah.....	10,658.87	.....	45,000.00	.....	70,600.00
60 Vermont.....	8,130.00	.....	45,000.00	.....	16,000.00
61 Virginia (Blacksburg).....	20,658.72	.....	30,000.00	.....	60,000.00
62 Virginia (Hampton).....	10,329.36	.....	15,000.00	.....	8 400.00
63 Washington.....	11,000.00	18,000.00	45,000.00	.....	4 243,622.00
64 West Virginia (Morgantown).....	6,000.00	.....	36,000.00	.....	138,000.00
65 West Virginia (Institute).....	.....	.....	9,000.00	.....	25,000.00
66 Wisconsin.....	13,251.46	12,149.23	45,000.00	6,453.60	886,765.00
67 Wyoming.....	7,370.67	5,256.42	45,000.00	.....	33,884.47
Total.....	802,208.12	398,520.69	2,265,199.54	303,682.91	7,860,107.03

¹ Lease of lands.² Including State appropriation for experiment station.³ All purposes.⁴ Including appropriation for increase of plant.⁵ Including data for School of Mines at Rolla.

colleges for year ended June 30, 1911.

Appropriation for farmers' institutes and extension work.	Appropriations for increase of plant.	Income from endowment other than Federal or State grants.	Fees and all other sources.			Total.	United States appropriations for experiment stations (acts of 1887 and 1906).
			Student fees.	Private benefactions.	Miscellaneous.		
\$1,250.00	\$11,500.00	520.00	1,380.00	\$13,817.54	1,090.12	40,659.16	-----
8,000.00	13,000.00	-----	20,518.43	2,000.00	3,319.11	120,107.54	30,000.00
10,000.00	22,541.93	99,200.50	11,802.00	528.00	19,221.20	188,175.47	30,000.00
6,066.10	8,383.22	-----	600.00	-----	-----	21,872.72	5
30,500.00	10,860.00	-----	130,421.18	104,898.49	146,455.90	1,545,608.40	30,000.00
4,500.00	10,000.00	-----	37,836.00	-----	28,606.18	172,405.50	28,638.29
3,000.00	-----	9,083.63	-----	33,689.49	189,635.49	15,000.00	8
7,500.00	62,500.00	-----	7,527.88	220.00	6,296.40	75,860.03	31,000.00
12,500.00	-----	18,929.78	1,500.00	1,477.36	1,495.21	21,207.09	-----
-----	-----	12,000.00	-----	846.81	1,500.00	40,346.81	30,000.00
-----	-----	2,199.50	4,926.20	7,149.58	7,149.58	123,729.28	12
-----	-----	-----	-----	-----	-----	23,000.00	13
-----	-----	160.00	-----	784.27	55,937.33	-----	14
2 12,000.00	51,000.00	-----	-----	1,956.18	214,393.89	30,000.00	15
-----	434,000.00	-----	244,346.88	-----	111,225.72	1,392,040.28	30,000.00
12,898.97	57,003.47	-----	59,896.51	-----	92,218.65	470,952.56	30,000.00
34,005.49	165,524.12	-----	69,534.71	-----	84,070.10	685,418.42	30,000.00
27,500.00	77,000.00	-----	17,027.00	-----	31,813.00	427,758.33	30,000.00
-----	-----	5,877.00	-----	4,922.01	143,856.01	30,000.00	20
-----	-----	7,429.81	-----	1,580.30	1,580.30	26,535.11	-----
-----	-----	13,025.75	-----	11,358.00	11,358.00	163,856.69	30,000.00
-----	750.00	-----	-----	963.96	31,796.71	-----	23
-----	4,000.00	-----	40,390.17	-----	25,936.80	222,741.97	30,000.00
6,000.00	-----	-----	30,122.28	-----	393.00	103,312.46	30,000.00
-----	-----	1,220.50	-----	-----	-----	10,220.50	26
8,125.00	121,152.88	-----	48,012.72	-----	70,370.59	389,774.50	30,000.00
-----	-----	354,548.82	156,130.07	19,212.40	579,197.97	-----	27
-----	10,913.31	-----	37,187.50	-----	71,182.65	397,997.61	30,000.00
36,029.38	541,000.00	-----	188,197.01	-----	15,783.95	1,578,399.89	28,000.00
7,500.00	84,400.00	-----	79,483.33	250.00	51,728.38	403,240.79	30,000.00
-----	7,500.00	-----	15,720.28	-----	2,259.51	68,251.53	32
-----	174,700.00	600.00	45,902.30	-----	57,747.16	835,197.96	30,000.00
-----	-----	600.00	-----	-----	-----	75,912.50	33
10,000.00	-----	10,562.85	-----	12,601.43	121,348.41	30,000.00	35
10,000.00	85,000.00	77,533.12	-----	58,928.94	682,172.06	30,000.00	36
500.00	55,000.00	16,859.50	16,000.00	5,133.41	263,087.34	30,000.00	37
-----	6,459.87	35,329.90	8,408.70	38,664.65	141,663.12	30,000.00	38
16,054.74	32,512.55	-----	26,272.71	39,142.72	46,027.90	243,646.96	30,000.00
-----	-----	4,621.39	-----	11,931.78	11,931.78	30,000.00	40
-----	23,000.00	404,058.78	485,507.83	329,024.60	189,483.31	1,767,936.62	30,375.00
-----	28,000.00	-----	68,912.64	-----	34,437.35	243,999.99	30,000.00
-----	4,350.00	-----	6,840.00	-----	5,119.00	41,109.00	44
-----	120,000.00	-----	21,930.60	-----	11,398.44	312,158.26	30,000.00
51,294.26	171,346.58	16,292.56	116,556.97	4,297.33	35,427.64	924,611.11	45
-----	149,700.00	-----	5,000.00	-----	9,000.00	318,575.83	30,000.00
-----	-----	-----	-----	-----	-----	45,700.00	46
-----	105,000.00	-----	19,355.25	-----	6,433.21	251,821.44	30,000.00
-----	-----	50,213.21	-----	-----	25,825.49	417,558.58	30,000.00
1,000.00	4,000.00	-----	32,856.33	-----	5,454.29	130,755.13	50
-----	3,512.36	-----	58,017.38	-----	9,195.05	119,551.39	30,000.00
-----	-----	13,056.00	-----	11,338.61	283,898.34	29,900.00	52
-----	-----	2,394.00	6,168.03	41,972.39	18,391.66	64,701.21	54
-----	-----	-----	145,413.54	-----	24,587.57	156,576.07	30,000.00
-----	11,400.00	-----	80,000.00	-----	11,718.29	173,207.86	30,000.00
-----	5,000.00	-----	8,608.94	-----	25,875.24	465,522.40	30,000.00
-----	6,000.00	31,800.51	53,591.34	222,558.40	6,986.33	136,900.00	57
-----	-----	84,391.73	-----	17,538.62	146,854.14	33,000.00	58
-----	103,699.08	-----	105,977.20	286,709.53	56,802.01	394,618.87	30,000.00
18,750.00	-----	-----	21,328.22	-----	1,830.36	257,852.40	30,000.00
-----	-----	21,012.98	96.00	-----	21,941.97	523,945.53	61
-----	8,550.00	-----	8,364.53	-----	2,768.71	379,642.19	30,000.00
127,000.00	214,135.25	4,648.91	315,111.27	45,463.15	154,933.07	1,824,910.94	30,000.00
-----	28,493.82	28.00	2,313.45	400.00	8,926.36	131,673.19	30,000.00
417,419.20	3,132,859.19	749,507.15	3,407,695.23	1,269,934.42	1,819,978.40	22,427,111.88	1,365,913.29

* Including income from other land grants.

† Income from privilege fertilizer inspection tax from which current expenses and expenses for extension work, increase in plant, etc., are paid.

§ This appropriation was for the benefit of the summer school.

TABLE 9.—*Additions to equipment of land-grant colleges, 1911.*

State or Territory.	Permanent endowment.	Buildings.	Library.	Apparatus.	Machinery.	Live stock.	Miscellane- ous.	Total.
Alabama (Auburn).....	\$507,08	\$1,242,07	\$1,998,02	\$231,21	\$1,176,35	-\$2,278,41	\$5,154,73	\$5,192,95
Alabama (Normal).....	15,317,54	3,600,00	300,00	1,050,00	376,00	1,639,00	14,081,35	11,700,00
2,650,00	3,200,00	5,033,35	1,509,00	5,000,00	1,200,00	500,00	772,00	650,904,13
Arizona.....	1,000,00	4,000,00	5,000,00	300,00	6,124,06	300,00	126,251,16	650,904,13
Kansas (Fayettleville).....	390,930,58	25,178,74	68,340,10	6,883,34	6,116,06	3,116,06	5,714,96	48,917,32
Arkansas (Pine Bluff).....	323,759,50	10,000,00	1,721,47	556,47	2,677,05	3,700,00	500,00	16,650,00
California.....	38,071,42	10,000,00	1,150,00	2,500,00	2,250,00	300,00	567,50	1,892,50
Colorado.....	1,50,000,00	8,300,00	1,000,00	14,000,00	829,30	128,00	1,000,00	56,300,00
Connecticut.....	2,500,00	800,00	1,000,00	1,635,07	707,00	1,283,34	548,74	3,633,43
Delaware (Newark).....	40,000,00	400,00	3,223,52	6,774,04	1,283,34	1,283,34	21,255,45	21,255,45
Dover.....	6,500,00	6,500,00	3,350,00	3,151,00	10,546,00	4,000,00	4,328,00	6,500,00
Florida (Gainesville).....	295,533,65	37,136,77	9,793,88	5,949,46	24,383,67	11,000,00	7,146,46	19,650,00
Tallahassee).....	210,00	200,000,00	44,000,00	44,580,00	245,000,00	2,300,00	10,000,00	334,443,67
Georgia (Athens).....	7,94,39	400,00	2,000,00	15,000,00	5,000,00	10,000,00	2,300,00	49,500,00
Georgia (Savannah).....	6,500,00	6,500,00	1,000,00	19,311,00	19,049,00	452,00	13,000,00	181,088,16
Iowa.....	119,331,16	72,000,00	1,000,00	1,000,00	1,000,00	1,000,00	124,812,00	124,812,00
Kansas.....	7,295,06	6,101,72	6,383,02	8,711,16	280,55	34,00	1,501,14	9,111,05
Kentucky (Lexington) ³	4,032,47	1,000,00	596,72	284,02	8,711,16	6,344,36	31,732,73	31,732,73
Louisiana (Frankfort).....	47,633,45	97,75	450,00	210,471,01	1,200,00	1,280,00	1,000,00	58,449,66
Michigan.....	27,000,00	262,44	25,000,00	600,00	800,00	210,00	469,14	1,930,00
Minnesota.....	12,000,00	25,000,00	20,000,00	5,000,00	5,000,00	42,500,00	12,000,00	2,341,58
Mississippi (Agricultural College).....	40,000,00	87,055,00	8,658,18	5,485,78	6,899,55	17,698,99	4,500,00	484,500,00
Mississippi (Alcorn).....	39,669,12	15,811,94	25,804,83	19,370,00	2,113,00	4,986,77	31,202,98	31,202,98
Missouri (College Park).....	1,200,00	1,200,00	1,200,00	5,000,00	3,000,00	820,00	4,500,00	47,333,00
Missouri (Princess Anne).....	15,842,98	25,000,00	8,500,00	9,614,00	1,713,00	1,800,00	726,00	19,994,29
Massachusetts (Amherst).....	5,740,90	5,740,90	3,579,00	3,493,40	1,222,70	1,222,70	35,221,63	35,221,63
Massachusetts (Boston).....	121,485,57	30,381,40	1,272,15	1,272,15	312,46	1,050,00	1,050,00	7,075,00
Michigan.....	68,457,01	927,00	6,131,26	6,131,26	2,000,00	1,000,00	1,000,00	1,000,00
New Hampshire.....	1,650,00	383,00	440,00	275,00	275,00	275,00	275,00	5,250,00
New Jersey.....	23,434,76	58,595,69	3,100,24	2,270,07	687,91	2,000,00	1,200,00	1,200,00
New Mexico.....	49,834,39	121,485,57	30,381,40	1,272,15	312,46	1,050,00	1,050,00	217,585,03
New York.....	927,00	383,00	440,00	275,00	275,00	275,00	275,00	5,250,00
North Carolina (West Raleigh).....	1,650,00	383,00	440,00	275,00	275,00	275,00	275,00	1,000,00
North Carolina (Greensboro).....	23,434,76	58,595,69	3,100,24	2,270,07	687,91	2,000,00	1,200,00	1,200,00

North Dakota.....	6,165,802.02	1,676,46	4,815,25	2,364,28	1,717,76	12,148,62
Ohio.....	51,221.12	19,892.56	40,109.84	20,523.02	7,268.50	188,524.39
Oklahoma (Stillwater).....	9,000.00	1,488.00	3,065.00	5,500.00	10,255.00	154,548.81
Oklahoma (Langston).....	161.50	.....	.....	2,000.00	20,968.00	50,276.00
Oregon.....	130,000.00	3,100.00	.....	2,000.00	197.00	1,000.00
Pennsylvania.....	4,026.00	65,663.24	252,900.00	4,000.00	6 20,000.00	3,358.50
Rhode Island.....	2,441.56	1,824.70	4,884.64	890.86	27,13.38	97,402.62
Porto Rico.....	4,092.67	867.17	3,501.63	2,148.57	1,727.57	11,719.33
South Carolina (Clemson College).....	534.03	42,791.36	905.33	211,266.33	4,121.44	18,016.93
South Carolina (Orangeburg).....	.....	.....	300.00	712.00	.....	75,999.96
South Dakota.....	.....	200.00	2,000.00	.....	1,000.00	1,012.00
Tennessee.....	158,700.00	2,006.64	2,665.26	2,752.41	827.00	3,200.00
Texas (College Station).....	133,000.00	9,748.00	20,168.00	42,650.00	6,520.00	2,930.25
Texas (Prairie View).....	11,400.00	.....	1,212.80	1,804.91	1,475.00	70,501.56
Utah.....	220,640.50	5,000.00	2,800.00	91.43	123.23	229,226.00
Vermont.....	.....	.....	.....	.....	553.84	12,875.00
Virginia (Blacksburg) ³	158,188.88	35,000.00	750.00	21,500.00	2,584.00	3,786.21
Virginia (Hampton).....	12,295.89	3,800.00	3,145.76	12,082.39	1,168.00	228,440.50
Washington.....	44,000.00	1,800.00	.....	2,12,500.00	250.00	1,022.88
West Virginia (Morgantown).....	300.00	.....	314.76	545.15	320.00	39,162.10
West Virginia (Institute).....	161,191.50	34,033.79	29,393.64	33,947.46	2,092.92	53,550.00
Wisconsin.....	33,137.24	25,304.69	2,412.50	6,509.59	1,912.88	3,084.91
Wyoming.....	31,500.00	.....	.....	3,762.04	67,605.81	330,421.34
Total.....	846,190.76	2,788,911.11	317,448.99	529,980.88	414,803.31	532,790.15

¹ Gift of Senator Guggenheim.² Including apparatus.³ No additions to equipment reported.⁴ Including machinery, apparatus, and live stock.⁵ Purchase of land.

TABLE 10.—*Disbursements from the United States Treasury to the States and Territories of the appropriations in aid of colleges of agriculture and the mechanic arts under the acts of Congress approved August 30, 1890, and March 4, 1907.*¹

State or Territory.	Year ending June 30, 1911.										
	1890	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900 ²
Alabama.....	\$15,000	\$16,000	\$17,000	\$18,000	\$19,000	\$20,000	\$21,000	\$22,000	\$23,000	\$24,000	\$25,000
Arizona.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Arkansas.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Colorado.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Connecticut.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Delaware.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Florida.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Hawaii.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Idaho.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000*	25,000*
Illinois.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Indiana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Iowa.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Kansas.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Kentucky.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Louisiana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Maine.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Maryland.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Massachusetts.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Michigan.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Minnesota.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Mississippi.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Missouri.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Montana.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Nebraska.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Nevada.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
New Hampshire.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
New Jersey.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
New Mexico.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
New York.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
North Carolina.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
North Dakota.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Ohio.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Oklahoma.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Oregon.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Pennsylvania.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Porto Rico.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
Rhode Island.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000
South Carolina.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000

South Dakota	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Tennessee.....	15,000	15,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Texas.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Utah.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Vermont.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Virginia.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Washington.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
West Virginia	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Wisconsin.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Wyoming.....	15,000	16,000	17,000	18,000	19,000	20,000	21,000	22,000	23,000	24,000	25,000	25,000	30,000	35,000	40,000	45,000
Total	660,000	704,000	782,000	864,000	912,000	960,000	1,008,000	1,056,000	1,104,000	1,152,000	1,200,000	1,440,000	1,750,000	2,000,000	2,250,000	2,500,000

¹ From the annual statement of the Commissioner of Education to the Secretary of the Interior, 1911.
² For each of the years ended June 30, 1901, 1902, 1903, 1904, 1905, 1906, and 1907 the sum of \$25,000 was paid to each of the 48 States and Territories included in this tabular statement, the total amount disbursed for each of the said years being \$1,200,000.

STATISTICS OF THE AGRICULTURAL

TABLE 11.—General

	Stations.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
1	Alabama (College)	Auburn.....	J. F. Duggar, M. S.....	Feb. —, 1883	Feb. 24, 1888
2	Alabama (Canebrake)	Uniontown.....	F. D. Stevens, B. S.....	Jan. 1, 1886	Apr. 1, 1888
3	Alabama.....	Tuskegee Institute	G. W. Carver, M. S. Agr.	Feb. 15, 1897	.....
4	Arizona.....	Tucson.....	R. H. Forbes, M. S.....	.....	—, 1889
5	Arkansas.....	Fayetteville.....	C. F. Adams, B. Agr., A. M., and M. D.	.....	Mar. 7, 1889
6	California.....	Berkeley.....	E. J. Wickson, A. M.....	—, 1873	Mar. —, 1888
7	Colorado.....	Fort Collins.....	C. P. Gillette, M. S.....	.....	Feb. —, 1888
8	Connecticut (State) ...	New Haven.....	E. H. Jenkins, Ph. D....	Oct. 1, 1875	May 18, 1887
9	Connecticut (Storrs) ...	Storrs.....	L. A. Clinton, M. S.....	.....	do
10	Delaware.....	Newark.....	Harry Hayward, M. S. ....	.....	Feb. 21, 1888
11	Florida.....	Gainesville.....	P. H. Rollis, M. S.....	.....	—, 1888
12	Georgia.....	Experiment.....	M. V. Calvin.....	Feb. 18, 1888	July 1, 1889
13	Idaho.....	Moscow.....	W. L. Carlyle, M. S.....	.....	Feb. 26, 1892
14	Illinois.....	Urbana.....	Eugene Davenport, M. Agr., LL. D.	.....	Mar. 21, 1888
15	Indiana.....	La Fayette	Arthur Goss, M. S., A. C.	.....	Jan. 1, 1888
16	Iowa.....	Ames.....	C. F. Curtiss, M. S., A. D. S.	.....	Feb. 17, 1888

¹ Includes only experiment stations in continental United States.

EXPERIMENT STATIONS.¹

statistics, 1911.

Number on staff.	Number of teachers on staff. ²	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1911.		Number of names on mailing list.	Principal lines of work.	1
			Number.	Pages.			
31	17	20	4	124	20,000	Field experiments; cooperative experiments with farmers; horticulture; plant breeding; soil improvement; feeding experiments; entomology; diseases of plants and animals; analyses of fertilizers.	1
1	1	1	2	52	1,500	Soil improvement; field experiments; plant breeding; diseases of plants.	2
20	20	20	2	52	1,500	Field experiments; horticulture; plant breeding; animal industry; poultry investigations; dairy ing.	3
12	.....	9	4	332	6,750	Botany; field experiments; improvement of ranges; horticulture, including olive products and date-palm culture; sheep-breeding experiments; plant breeding; irrigation; dry farming.	4
18	8	10	11	84	20,000	Chemistry; soil physics; field experiments; horticulture; plant breeding; diseases of plants; animal husbandry and pathology; feeding and breeding experiments; entomology; nursery inspection; dairy ing; poultry experiments.	5
60	25	16	27	1,033	12,000	Chemistry; soils; bacteriology; fertilizer control; field experiments; horticulture, viticulture, and zymology; botany; meteorology; animal husbandry; entomology; dairy ing; poultry culture; drainage and irrigation; silviculture; reclamation of alkali lands; animal and plant pathology; nutrition investigations.	6
28	11	19	23	744	18,870	Chemistry; meteorology; field experiments; horticulture; forestry; plant breeding; diseases of plants; animal husbandry; poultry investigations; veterinary investigations; entomology; bacteriology; irrigation.	7
18	1	5	4	643	9,892	Chemistry; analysis and inspection of fertilizers, foods, drugs, and feeding stuffs; inspection of Babcock-test apparatus; nurseries; apiaries; diseases of plants; plant selection and breeding; seed testing; forestry; field experiments; entomology; bacteriology; irrigation.	8
13	6	7	6	420	10,000	Dairy and soil bacteriology; field experiments; horticulture; feeding and breeding experiments; poultry experiments and diseases; dairy ing, including soft-cheese manufacture; embryology.	9
14	4	6	4	159	7,500	Chemistry; field experiments; horticulture; diseases of plants and animals; animal husbandry.	10
17	.....	7	5	212	15,000	Chemistry; soils; field experiments; horticulture; plant physiology; diseases of plants; feeding experiments; entomology.	11
8	.....	7	95	13,500	Chemistry; field experiments; bacteriology; horticulture; plant breeding; plant and animal diseases; entomology; feeding experiments; dairy ing.	12	
26	16	9	3	136	4,600	Chemistry; physics; bacteriology; botany; field experiments; horticulture; plant breeding and diseases; entomology; animal husbandry; irrigation; dairy ing; dry farming; wheat investigations.	13
70	27	25	11	420	44,000	Soil chemistry; soil physics; bacteriology; pot and field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; dairy ing.	14
51	13	13	12	692	36,357	Chemistry; soils; field experiments; feeding experiments; horticulture; plant breeding; diseases of plants and animals; entomology; dairy ing; feeding stuff and fertilizer control; agricultural extension work.	15
39	16	.....	12	190	15,500	Chemistry; botany; soils; field experiments; horticulture; plant breeding; forestry; diseases of plants; animal husbandry; poultry investigations; entomology; dairy ing; rural engineering; good-roads investigations.	16

² Including substations.

TABLE 11.—General

	Stations.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
17	Kansas.....	Manhattan.....	E. H. Webster, B. Agr., M. S.	.....	Feb. 8, 1888
18	Kentucky.....	Lexington.....	M. A. Scovell, M. S., Ph. D.	Sept. —, 1885	Apr. —, 1888
19	Louisiana (Sugar)	New Orleans.....	W. R. Dodson, A. B., B. S.	Sept. —, 1885	.....
20	Louisiana (State).....	Baton Rouge.....	do.....	Apr. —, 1886	—, 1888
21	Louisiana (North)....	Calhoun.....	do.....	May —, 1887	July 1, 1908
22	Louisiana (Rice).....	Crowley.....	do.....	.....	.....
23	Maine.....	Orono.....	C. D. Woods, Sc. D.	Mar. —, 1885	Oct. 1, 1887
24	Maryland.....	College Park.....	H. J. Patterson, B. S.	—, 1888	Mar. 9, 1888
25	Massachusetts.....	Amherst ²	W. P. Brooks, Ph. D.	—, 1882	Mar. 2, 1888
26	Michigan.....	East Lansing.....	R. S. Shaw, B. S. A.	.....	Feb. 26, 1888
27	Minnesota.....	St. Anthony Park, St. Paul.	A. F. Woods, M. A.	Mar. 7, 1885	—, 1888
28	Mississippi.....	Agricultural College.	J. W. Fox, M. S.	.....	Jan. 27, 1888
29	Missouri (College)....	Columbia.....	F. B. Mumford, M. S.	.....	Jan. —, 1888
30	Missouri (Fruit).....	Mountain Grove...	Paul Evans.....	Feb. 1, 1900	.....
31	Montana.....	Bozeman.....	F. B. Linfield, B. S. A.	.....	July 1, 1893
32	Nebraska.....	Lincoln.....	E. A. Burnett, B. S.	Dec. 16, 1884	June 14, 1887

¹ Including substations.² Including work at substations: Asparagus, Concord, Cranberry, and Wareham.

statistics, 1911—Continued.

Number on staff.	Number of teachers on staff. ¹	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1911.	Number of names on mailing list.		Principal lines of work.	17	
				Number.	Pages.			
60	33	18	15	653	19,331	Soils; inspection of feeding stuffs and fertilizer control; horticulture; plant breeding; forestry; field experiments; feeding and digesting experiments; milling and baking tests; correlation of characteristics of wheat; poultry experiments; diseases of animals; hog-cholera serum; entomology; dairying; extermination of prairie dogs and gophers; irrigation.	17	
34	4	5	12	289	15,000	Chemistry; soils; bacteriology; inspection of fertilizers, foods, drugs, feeding stuffs, seeds, orchards, and nurseries; field experiments; horticulture; plant breeding; animal husbandry; diseases of plants and animals; entomology; apiculture; dairying.	18	
7	23	3	8	9	300	13,000	Chemistry; bacteriology; soils; field experiments; horticulture; sugar making; drainage; irrigation. Botany; bacteriology; inspection of fertilizers, feeding stuffs, and Paris green; horticulture; animal husbandry; diseases of animals; entomology.	19
4							Chemistry; soils; fertilizers; field experiments; horticulture; feeding experiments; stock raising; poultry experiments; dairying.	20
2	23	-----	13	911	12,000	Rice experiments.	21	
15							Chemistry; botany; analysis and inspection of foods, drugs, insecticides, fungicides, fertilizers, concentrated commercial feeding stuffs, and agricultural seeds; calibration of creamery glassware; horticulture; plant pathology; biology; poultry breeding; plant breeding; entomology.	22
31	-----	-----	9	636	20,000	Chemistry; meteorology; analysis and inspection of fertilizers and concentrated commercial feeding stuffs; inspection of creamery glassware and nurseries; pot, cylinder, and field experiments; horticulture; plant breeding; diseases of plants and animals; digestion and feeding experiments; entomology; dairying; effect of electricity on plant growth.	23	
29	14	7	15	571	62,250	Chemistry; analysis and control of fertilizers; bacteriology; field experiments; horticulture; forestry; plant breeding; diseases of plants and animals; feeding and breeding experiments; poultry culture; entomology; stable hygiene.	24	
56	27	-----	5	224	16,435	Chemistry; soils; fertilizers; field experiments; horticulture; forestry; diseases of plants and animals; plant and animal breeding; animal nutrition; entomology; dairying; farm management; ventilation; farm statistics.	25	
27	5	7	13	445	25,000	Fertilizers; field experiments; horticulture; biology; plant breeding; animal husbandry; diseases of animals; poultry culture; entomology; dairying; agricultural engineering.	26	
52	34	34	12	467	21,785	Chemistry; soil survey; botany; field experiments; horticulture; diseases of plants and animals; feeding experiments; animal and plant breeding; entomology; dairying.	27	
4	18	9	11	10	355	11,106	Chemistry; meteorology; botany; field experiments; dry farming; horticulture; feeding and breeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage.	28
34							Chemistry; botany; meteorology; soils; field experiments; horticulture; plant breeding; diseases of plants and animals; forestry; feeding and breeding experiments; entomology; dairying; irrigation.	29
3	31	-----	-----	-----	-----	-----	30	
34							31	
3	32	-----	-----	-----	-----	-----	32	

³ In 1882 the State organized a station here and maintained it until June 18, 1895, when it was combined with the Hatch station at the same place.

TABLE 11.—*General*

	Stations.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
33	Nevada.....	Reno.....	J. E. Stubbs, M. A., D. D., LL. D.	.....	Dec. —, 1887
34	New Hampshire.....	Durham.....	J. C. Kendall, B. S.....	.....	Aug. 4, 1887
35	New Jersey (State)....	New Brunswick...	J. G. Lipman, Ph. D. ² ...	Mar. 10, 1880	.....
36	New Jersey (College).....	do.....	do.....	.....	Apr. 26, 1888
37	New Mexico.....	Agricultural College.	Luther Foster, M. S. A.....	.....	Dec. 14, 1889
38	New York (State).....	Geneva.....	W. H. Jordan, D. Sc., LL. D.	Mar. —, 1882	.....
39	New York (Cornell)...	Ithaca.....	L. H. Bailey, M. S., LL. D.	—, 1879	Apr. —, 1888
40	North Carolina (College).	West Raleigh.....	C. B. Williams, M. S.....	Mar. 12, 1877	Mar. 7, 1887
41	North Carolina (State).	Raleigh.....	B. W. Kilgore, M. S.....	July 1, 1907	.....
42	North Dakota.....	Agricultural College.	J. H. Worst, LL. D.,.....	.....	Mar. —, 1890
43	Ohio.....	Wooster.....	C. E. Thorne, M. S. A....	Apr. 25, 1882	Apr. 2, 1888
44	Oklahoma.....	Stillwater.....	J. A. Wilson, B. Agr.....	.....	Dec. 25, 1890
45	Oregon.....	Corvallis.....	James Withycombe, M. Agr.	.....	July —, 1888
46	Pennsylvania.....	State College.....	T. F. Hunt, D. Agr., D. Sc.	.....	June 30, 1887
47	Rhode Island.....	Kingston.....	H. J. Wheeler, Ph. D.....	.....	July 30, 1888
48	South Carolina.....	Clemson College..	J. N. Harper, B. S., M. Agr.	.....	Jan. —, 1888
49	South Dakota.....	Brookings.	J. W. Wilson, M. S. A.....	.....	Mar. 13, 1887

¹ Including substations.

statistics, 1911—Continued.

Number on staff.	Number of teachers on staff. ²	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1911.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
15	9	9	9	207	4,000	Chemistry; meteorology; botany; soils; field experiments; horticulture; plant breeding; forestry; animal feeding and breeding; plant diseases; veterinary science and bacteriology; zoology; entomology; irrigation.	33
17	13	6	6	148	15,700	Chemistry; botany; field experiments; horticulture; plant breeding; breeding experiments; entomology.	34
14	6	7	5	310	7,150	Chemistry; oyster culture; botany; analyses of fertilizers, foods, commercial feeding stuffs, and insecticides; pot, cylinder, and field experiments; horticulture; floriculture; plant breeding; forestry; diseases of plants and animals; animal husbandry; dairy husbandry; poultry experiments; entomology; soil chemistry and bacteriology; soil surveys; irrigation.	35
13	4	2	5	389			36
21	20	20	5	249	4,803	Chemistry; botany; soils; field crops; dry farming; horticulture; cactus investigations; nutrition; plant diseases; entomology; dairying; irrigation.	37
33	.....	16	24	917	47,500	Chemistry; bacteriology; meteorology; fertilizers; analysis and control of fertilizers; inspection of feeding stuffs, Paris green, and creamery glassware; field experiments; horticulture; plant breeding; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.	38
45	.....	.....	30	2,582	29,000	Chemistry; soils; field experiments; farm crops; farm management; horticulture; plant breeding; plant physiology; diseases of plants; feeding and breeding experiments; poultry husbandry; entomology; dairying.	39
18	7	2	9	264	17,500	Chemistry; soils; field experiments; horticulture; nitrification experiments; diseases of plants and animals; animal husbandry; poultry experiments; dairying; tests of farm machinery.	40
31	.....	.....	13	.....	37,500	Chemistry; soils; field experiments; horticulture; diseases of animals; feeding experiments; entomology; fertilizer experiments and analyses; inspection of foods and stock feeds; cooperative demonstration work with farmers; farmers' institutes.	41
44	21	11	47	341	15,000	Chemistry; soils; botany; field experiments; plant breeding; horticulture; forestry; diseases of plants and animals; analysis of foods and spraying materials; seed inspection; inspection and analysis of paints, drugs, proprietary products, and feeding stuffs; feeding and breeding experiments; poultry experiments; milling and chemical tests of wheat; drainage; farm engineering.	42
58	.....	24	21	520	50,000	Chemistry; soils; field experiments; botany; horticulture; plant breeding; forestry; diseases of plants; feeding experiments; entomology; nutrition; farm management; dairying.	43
17	10	7	9	79	35,000	Chemistry; field experiments; horticulture; forestry; botany; bacteriology; animal husbandry; dairying; veterinary science; entomology.	44
39	15	17	5	96	12,000	Chemistry; bacteriology; soils; fertilizers; field crops; horticulture; plant breeding and selection; diseases of plants; feeding experiments; poultry experiments; entomology; dairying; irrigation.	45
53	15	22	11	532	42,265	Chemistry; meteorology; fertilizers; horticulture; forestry; plant diseases; field experiments; feeding experiments; dairying; poultry experiments.	46
14	4	3	8	57	11,284	Chemistry; meteorology; soils; analysis and inspection of fertilizers and feeding stuffs; field and pot experiments; horticulture; poultry diseases, poultry feeding, and pigeon and poultry breeding.	47
19	2	5	8	103	17,500	Chemistry; soils; botany; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; dairying.	48
20	17	4	10	248	22,000	Chemistry; botany; horticulture; field experiments; plant breeding; diseases of plants and animals; animal husbandry; dairying.	49

² Acting director.

TABLE 11.—*General*

	Stations.	Location.	Director.	Date of original organization.	Date of organization under Hatch Act.
50	Tennessee.....	Knoxville.....	H. A. Morgan, B. S. A....	June 8, 1882	Aug. 4, 1887
51	Texas.....	College Station.....	H. H. Harrington, M. S., LL. D.	.....	Jan. 25, 1888
52	Utah.....	Logan.....	E. D. Ball, Ph. D.....	.....	—, 1890
53	Vermont.....	Burlington.....	J. L. Hills, Sc. D.....	Nov. 24, 1886	Feb. 28, 1888
54	Virginia.....	Blacksburg.....	S. W. Fletcher, Ph. D.....	.....	Oct. 16, 1888
55	do.....	Norfolk.....	T. C. Johnson, B. S. Agr., A. M.	Feb. —, 1907	.....
56	Washington.....	Pullman.....	R. W. Thatcher, B. S., M. A.	.....	—, 1891
57	West Virginia.....	Morgantown.....	J. H. Stewart, M. A.....	.....	—, 1887
58	Wisconsin.....	Madison.....	H. L. Russell, Ph. D.....	—, 1883	—, 1887
59	Wyoming.....	Laramie.....	H. G. Knight, A. M.....	.....	Mar. 1, 1891
	Total.....	.....	.....	.....	.....

¹ Including substations.

statistics, 1911—Continued.

Number on staff.	Number of teachers on staff. ¹	Number of persons on staff who assist in farmers' institutes.	Publications during fiscal year 1911.		Number of names on mailing list.	Principal lines of work.	
			Number.	Pages.			
21	7	9	6	199	11,012	Chemistry; soil investigations; inspection of fertilizers; field experiments; horticulture; plant breeding; seeds; weeds; diseases of plants and animals; feeding experiments; entomology; dairying; apiculture.	50
24	2	.....	4	137	34,000	Chemistry; examination and comparison of commercial feeding stuffs and fertilizers; soils; field experiments; horticulture; plant breeding; feeding experiments; diseases of plants and animals and selection; entomology; cotton investigations.	51
26	9	8	6	194	10,500	Chemistry of soils; field experiments; horticulture; diseases of plants; breeding and feeding experiments; poultry experiments; entomology; irrigation and drainage; arid farming.	52
18	7	4	10	496	14,000	Chemistry; botany; bacteriology; analysis and control of fertilizers and feeding stuffs; inspection of creamery glassware; horticulture; diseases of plants; feeding and breeding experiments; dairying.	53
21	6	.....	5	148	23,000	Chemistry; field experiments; horticulture; plant breeding; soil bacteriology; mycology; breeding and feeding experiments; diseases of animals; dairying.	54
5	.....	3	2	43	7,400	Field experiments; plant breeding; plant diseases; entomology.	55
32	14	10	5	179	15,350	Chemistry; plant physiology; bacteriology; soils; field experiments; horticulture; plant breeding; diseases of plants; feeding and breeding experiments; veterinary science; entomology; irrigation; dry farming; clearing logged-off lands.	56
17	1	.....	3	97	7,500	Chemistry; effect of pressure in the preservation of fruits, vegetables, and milk; artificial fixation of atmospheric nitrogen; analysis and control of fertilizers; soils; field experiments; horticulture; diseases of plants and animals; inspection of orchards and nurseries; feeding and breeding experiments; poultry experiments; entomology; dairying.	57
71	61	8	27	835	17,000	Chemistry; bacteriology; soils; field experiments; agronomy; tobacco and cranberry culture; horticulture; plant breeding; plant pathology; breeding and feeding experiments; poultry experiments; veterinary science; entomology; dairying; irrigation and drainage; agricultural engineering; agricultural economics; home economics; extension.	58
13	8	8	5	280	5,700	Chemistry; mycology; botany; meteorology; soils; range improvement; fertilizers; field experiments; plant selection; poisonous plant investigations; food analysis; breeding and feeding experiments; wool investigation; veterinary science; irrigation; effects of alkali on structural and other material.	59
1,564	573	485	566	20,699	1,012,520		

TABLE 12.—Revenue and

Stations.	Federal.		State.	Individuals and communities.	Fees.	Farm products.
	Hatch fund.	Adams fund.				
1 Alabama (College).....	\$15,000.00	\$15,000.00	\$13,500.00	.....	.....	\$775.76
2 Alabama (Canebrake) ¹.....	.....	.....	(8)	.....	.....	.....
3 Alabama (Tuskegee).....	.....	.....	.....	.....	.....	.....
4 Arizona.....	15,000.00	15,000.00	.....	\$2,500.00	.....	2,529.57
5 Arkansas.....	15,000.00	15,000.00	.....	.....	.....	4,156.86
6 California.....	15,000.00	15,000.00	69,750.00	.....	\$10,000.00	1,000.00
7 Colorado.....	15,000.00	15,000.00	.....	.....	.....	.....
8 Connecticut (State).....	7,500.00	7,500.00	19,650.00	17,367.65	11,200.00	87.79
9 Connecticut (Storrs).....	7,500.00	7,500.00	2,000.00	.....	.....	.....
10 Delaware.....	15,000.00	15,000.00	5,000.00	.....	.....	1,988.40
11 Florida.....	15,000.00	15,000.00	.....	.....	70.00	709.96
12 Georgia.....	15,000.00	15,000.00	710.00	.....	.....	4,553.33
13 Idaho.....	15,000.00	15,000.00	.....	.....	.....	1,956.18
14 Illinois.....	15,000.00	15,000.00	138,000.00	.....	.....	21,874.71
15 Indiana.....	15,000.00	15,000.00	101,377.38	.....	.....	.....
16 Iowa.....	15,000.00	15,000.00	43,008.24	.....	.....	10,878.64
17 Kansas.....	15,000.00	15,000.00	15,000.00	.....	7,732.69	1,323.59
18 Kentucky.....	15,000.00	15,000.00	29,212.21	19,101.87	34,787.37	11,376.17
19 Louisiana.....	15,000.00	15,000.00	24,000.00	250.51	2,000.00	3,763.04
20 Maine.....	15,000.00	15,000.00	5,200.00	.....	.....	.....
21 Maryland.....	15,000.00	15,000.00	14,000.00	.....	.....	7,871.42
22 Massachusetts.....	15,000.00	15,000.00	13,500.00	25.00	6,239.83	2,068.85
23 Michigan.....	15,000.00	15,000.00	5,000.00	1,187.87	4,540.00	.....
24 Minnesota.....	15,000.00	15,000.00	107,033.36	.....	.....	.....
25 Mississippi.....	15,000.00	15,000.00	29,150.00	.....	.....	7,280.89
26 Missouri (College).....	15,000.00	15,000.00	5,383.83	29,238.79	13,966.97	4,366.38
27 Missouri (Fruit) ².....	.....	.....	.....	.....	.....	.....
28 Montana.....	15,000.00	15,000.00	44,353.99	9,432.66	6,858.19	.....
29 Nebraska.....	15,000.00	15,000.00	6 65,000.00	.....	.....	35,808.33
30 Nevada.....	15,000.00	15,000.00	.....	.....	.....	.....
31 New Hampshire.....	15,000.00	15,000.00	.....	.....	.....	.....
32 New Jersey (State).....	.....	.....	27,000.00	.....	.....	.....
33 New Jersey (College).....	15,000.00	15,000.00	.....	.....	.....	.....
34 New Mexico.....	15,000.00	15,000.00	.....	1,168.88	141.50	1,488.13
35 New York (State).....	1,500.00	1,500.00	108,143.28	(8)	(8)	(8)
36 New York (Cornell).....	13,500.00	13,500.00	.....	.....	.....	.....
37 North Carolina (College).....	15,000.00	15,000.00	.....	.....	.....	6,287.22
38 North Carolina (State).....	.....	.....	.....	.....	.....	.....
39 North Dakota.....	15,000.00	15,000.00	15,739.03	.....	.....	.....
40 Ohio.....	15,000.00	15,000.00	200,090.00	.....	.....	10,892.51
41 Oklahoma.....	15,000.00	15,000.00	.....	.....	.....	.....
42 Oregon.....	15,000.00	15,000.00	55,493.89	.....	.....	4,483.75
43 Pennsylvania.....	15,000.00	15,000.00	.....	.....	17,705.00	12,976.87
44 Pennsylvania (Nutrition) ³.....	.....	.....	.....	.....	.....	.....
45 Rhode Island.....	15,000.00	15,000.00	.....	.....	.....	.....
46 South Carolina.....	15,000.00	15,000.00	.....	.....	.....	3,154.03
47 South Dakota.....	15,000.00	15,000.00	7,000.00	.....	1,688.76	6,102.47
48 Tennessee.....	15,000.00	15,000.00	.....	.....	.....	.....
49 Texas.....	15,000.00	15,000.00	.....	.....	.....	.....
50 Utah.....	15,000.00	15,000.00	13,036.18	.....	.....	4,240.60
51 Vermont.....	15,000.00	15,000.00	2,142.93	210.31	2,795.48	.....
52 Virginia.....	15,000.00	15,000.00	3,250.00	.....	.....	5,561.33
53 Washington.....	15,000.00	15,000.00	18,146.00	.....	730.00	358.93
54 West Virginia.....	15,000.00	15,000.00	11,500.00	.....	13,251.69	7,390.75
55 Wisconsin.....	15,000.00	15,000.00	15,000.00	.....	10,324.00	9,000.00
56 Wyoming.....	15,000.00	15,000.00	.....	.....	.....	6,381.41
Total.....	720,000.00	720,000.00	1,246,470.32	80,483.54	144,031.48	202,687.87

¹ Including all balances.² No report received.³ Amount of appropriation not reported.⁴ Including \$12,800 for purchase of cranberry bog.

additions to equipment, 1911.

Miscella-neous. ¹	Total.	Additions to equipment.							Total.
		Build-ings.	Library.	Appa-ratus.	Farm im-plements.	Live-stock.	Miscella-neous.		
\$2,593.66	\$46,869.42	\$507.00	.....	\$2,000.00	\$210.00	\$1,176.00	\$275.00	\$4,168.00	1
7,950.51	42,980.08	963.86	\$55.35	397.04	563.84	112.50	420.41	2,513.00	2
18,871.04	53,027.90	2,041.00	302.08	1,222.41	2,288.59	353.68	1,768.05	7,925.81	3
12,500.00	123,250.00	30,635.52	849.22	3,231.97	6,091.05	6,718.55	5,999.31	53,525.62	4
44,424.42	74,424.42	319.01	318.23	1,317.68	274.93	.....	731.70	2,961.55	5
57.16	63,362.60	1,170.76	564.21	549.96	131.51	11.00	848.07	3,275.51	6
1,190.72	18,190.72	307.63	122.08	100.53	168.03	37.60	519.65	1,255.52	7
574.12	31,354.08	41,822.81	476.08	1,250.21	324.79	7,500.00	430.11	51,804.00	8
35,263.33	.....	155.41	.....	562.58	1,008.10	883.09	.....	2,609.18	9
31,956.18	1,776.57	78.28	1,498.39	1,482.24	179.55	.....	14,503.16	19,518.19	10
28,016.59	217,891.30	2,000.00	33.72	983.24	6,820.91	6,869.00	.....	16,706.87	11
67,517.31	198,894.69	27,496.00	813.52	1,206.83	936.43	11,816.05	131,543.63	173,812.46	12
7,119.73	91,066.01	1,615.94	25.00	1,103.83	746.01	3,370.17	5,502.32	12,363.27	13
15,277.75	69,334.03	.....	140.97	513.44	2,966.01	7,743.25	1,638.44	13,002.11	14
16,352.57	140,830.19	7,965.65	1,120.83	2,122.71	428.35	788.00	1,789.83	14,215.37	15
2,591.47	62,605.02	4,871.80	183.27	2,422.67	1,934.31	1,938.15	.....	11,350.20	16
14,658.93	49,858.93	650.00	865.00	630.00	500.00	175.00	.....	2,820.00	17
429.97	52,301.39	1,168.28	550.32	58.94	1,218.14	1,227.00	278.60	4,501.28	18
13,800.17	65,633.85	9,700.00	350.00	1,321.00	.....	.....	14,035.00	24,406.00	19
2,570.75	43,298.62	1,045.22	1,120.77	2,970.12	661.87	439.95	.....	6,237.98	20
137,033.36	4,225.00	7,823.93	11,686.75	1,067.83	4,387.70	20,207.40	49,398.61	24,406.00	21
5,771.96	72,202.85	3,770.00	102.40	696.31	1,216.50	12,952.94	669.20	19,407.35	22
22,167.56	105,123.53	17,829.48	35.44	2,693.76	391.35	3,599.20	906.80	25,456.03	23
90,644.84	17,956.60	339.79	306.26	2,804.36	1,888.17	370.00	23,665.18	27	
723,251.82	154,060.15	20,000.00	.....	2,500.00	1,050.00	3,700.00	7,000.00	34,250.00	24
5,204.85	35,204.85	1,771.81	170.10	931.93	108.20	1,235.25	1,864.34	8,081.63	25
5,381.03	35,381.03	.....	.....	669.97	109.28	122.10	638.53	2,055.81	26
47,000.00	1,050.00	.....	123.75	211.30	778.62	.....	19.05	2,182.72	27
30,000.00	1,076.02	1,032.55	1,687.07	228.08	.....	.....	4,023.72	3,000.00	28
319.53	33,118.04	1,272.15	687.91	2,000.00	.....	1,000.00	4,960.06	3,000.00	29
4,432.57	115,575.85	3,189.94	958.73	305.99	450.06	.....	161.92	5,066.64	30
27,000.00	887.71	152.06	124.72	53.09	.....	.....	1,217.58	2,499.35	31
90.72	36,377.94	200.00	361.65	237.70	600.00	600.00	500.00	9,100.00	32
5,000.00	.....	300.00	500.00	300.00	3,000.00	3,000.00	500.00	4,499.35	33
14,980.51	60,719.54	165,802.02	1,676.46	815.25	2,364.28	1,717.76	12,148.62	188,524.39	34
160,376.52	401,359.03	20,000.00	1,297.13	2,880.50	1,437.50	2,067.50	.....	27,682.93	35
3,764.64	33,764.64	2,166.79	459.18	1,499.03	168.51	206.72	.....	4,500.23	36
10,231.14	100,208.78	474.40	71.70	1,318.21	1,391.24	32.00	1,017.20	4,304.75	37
4,766.35	65,448.22	4,042.09	302.09	2,384.65	421.14	654.00	.....	7,803.97	38
5,002.80	35,002.80	934.56	735.32	389.10	360.46	270.20	285.18	2,974.52	39
3,992.04	37,146.07	1,056.63	628.95	198.49	988.01	1,604.52	.....	4,506.60	40
4,306.29	49,097.52	.....	200.00	820.00	180.00	230.00	600.00	2,030.00	41
7,323.64	37,323.64	6,718.10	593.10	1,660.09	1,855.18	827.00	765.25	12,418.72	42
1,980.92	31,980.92	887.38	243.84	327.59	756.05	1,652.68	196.90	4,064.44	43
520.72	47,797.50	629.21	141.79	1,465.83	1,131.49	706.50	170.82	4,245.64	44
9.89	35,158.61	1,500.00	296.13	1,011.35	24.40	721.00	.....	3,552.88	45
3,873.99	42,685.32	2,895.96	65.00	119.00	150.00	.....	831.71	4,061.67	46
49,284.93	3,050.00	44.92	1,283.69	683.37	.....	.....	.....	5,061.98	47
4,169.37	66,311.81	1,287.95	767.27	2,222.15	849.34	115.00	.....	5,241.71	48
64,324.00	13,900.00	1,000.00	2,324.00	1,214.00	1,656.00	1,702.00	21,796.00	55	49
336.11	36,717.52	3,985.84	127.00	1,295.36	350.00	743.90	670.20	7,172.30	56
548,751.84	3,662,425.05	448,708.75	30,148.02	74,847.74	54,689.53	99,594.68	231,717.04	939,705.76	57

⁶ For substations.⁶ Including appropriation for biennium ending March 31, 1913.⁷ Including balances for substations.⁸ Information not available.

TABLE 13.—*Expenditures from United States appropriation of March 2, 1887, for the agricultural experiment stations for the year ended June 30, 1911.*

	Stations.	Classified expenditures.						Seeds, plants, and sundry supplies.
		Amount of appropri- ation.	Salaries.	Labor.	Publica- tions.	Postage and sta- tionery.	Freight and express.	
Alabama.....	\$15,000.00	\$8,358.26	\$1,545.35	\$808.72	\$390.96	\$345.00	\$71.02	\$462.26
Arizona.....	15,000.00	7,109.36	2,274.08	1,068.60	725.90	329.00	222.88	325.88
Arkansas.....	15,000.00	8,222.69	1,873.60	600.00	400.87	165.88	206.07	337.30
California.....	15,000.00	4,415.62	866.39	866.39	866.39	23.82	142.90	22.88
Colorado.....	15,000.00	7,634.33	1,124.95	3,098.28	523.85	85.41	142.90	583.89
Connecticut (State).....	7,500.00	6,694.20	195.00	610.80	63.78	8.34	18.36	156.92
Connecticut (Stores).....	7,500.00	6,116.52	587.86	587.86	297.94	289.23	232.98	129.78
Delaware.....	15,000.00	5,373.29	4,354.90	307.02	374.92	123.54	160.11	682.59
Florida.....	15,000.00	6,708.51	3,079.93	1,297.79	706.20	339.48	271.12	5.25
Georgia.....	15,000.00	7,421.64	3,241.25	749.44	664.33	319.92	691.34	440.86
Idaho.....	15,000.00	8,181.20	2,139.31	2,664.36	1,143.94	432.32	61.77	73.44
Illinois.....	15,000.00	9,188.06	2,664.36	1,143.94	432.32	61.77	120.00	374.18
Indiana.....	15,000.00	9,295.00	973.51	1,348.19	278.40	30.35	223.47	211.06
Iowa.....	15,000.00	7,000.00	1,137.61	288.66	106.91	148.18	214.99	211.06
Kansas.....	15,000.00	6,000.00	4,254.64	37.97	171.39	116.01	399.66	926.13
Louisiana.....	15,000.00	10,133.34	1,619.65	157.80	678.41	152.09	134.09	153.17
Maine.....	15,000.00	12,275.34	2,214.19	685.31	84.02	7.02	137.50	185.17
Maryland.....	15,000.00	5,600.83	1,980.51	158.25	454.51	416.05	551.02	641.56
Massachusetts.....	15,000.00	11,200.09	2,243.98	366.18	2.89	1.38	194.01	38.99
Michigan.....	15,000.00	13,299.05	321.49	8.50	282.15	147.31	73.76	478.69
Minnesota.....	15,000.00	8,288.26	2,298.74	1,524.11	190.48	268.71	233.07	638.93
Mississippi.....	15,000.00	9,933.33	1,764.93	2,070.96	313.32	457.44	250.00	642.50
Missouri.....	15,000.00	5,329.80	2,358.93	697.88	557.79	138.26	387.83	576.93
Montana.....	15,000.00	7,549.02	2,398.24	1,069.82	946.61	64.99	91.90	402.11
Nevada.....	15,000.00	8,594.16	2,471.97	2,131.11	111.12	53.81	296.36	219.88
New Hampshire.....	15,000.00	6,302.96	5,001.90	722.00	600.24	240.10	1,045.30	78.50
New Jersey.....	15,000.00	6,946.36	1,609.44	558.66	438.60	44.33	414.14	76.49
New Mexico.....	15,000.00	8,691.65	697.88	1,106.08	288.69	278.33	253.61	144.14
New York (State).....	15,000.00	7,649.96	3,095.92	1,109.73	288.69	288.69	32.26	32.26
New York (Cornell).....	13,500.00	7,078.20	2,497.43	1,689.27	401.55	79.79	12.05	372.90
North Carolina.....	15,000.00	6,186.94	2,588.75	620.49	42.11	188.37	295.70	11.55
North Dakota.....	15,000.00	9,860.52	3,617.67	363.51	1,414.57	1.43	42.70	308.58
Ohio.....	15,000.00	12,503.31	2,646.81	776.22	249.10	125.43	82.93	573.84
Oklahoma.....	15,000.00	8,840.43	2,446.81	409.43	23.33	168.14	57.15	10.45
Oregon.....	15,000.00	10,358.65	2,374.86	281.76	180.85	3.25	114.21	287.72
Pennsylvania.....	15,000.00	7,466.23	1,986.77	1,738.38	417.83	223.22	22.22	584.58
Rhode Island.....	15,000.00	8,567.50	1,975.87	159.33	417.83	223.22	23.14	173.32

Stations.										Classified expenditures.					
	Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.				
South Carolina.....	15,000.00	8,033.33	2,292.50	786.58	171.34	184.15	65.48	188.53	385.37	483.23	299.05				
South Dakota.....	15,000.00	7,104.20	2,082.26	2,331.54	109.63	209.36	7.20	123.70	233.70	81.11	260.79				
Tennessee.....	15,000.00	8,340.00	2,686.46	814.69	325.92	349.66	231.27	8.50	138.72	546.81	546.81				
Texas.....	15,000.00	6,904.83	1,840.23	764.82	349.66	421.27	24.03	21.84	24.03	40.11	58.09				
Utah.....	15,000.00	7,880.28	4,207.16	143.12	489.36	653.25	43.94	881.50	291.79	164.95	2,324.95	538.21			
Vermont.....	15,000.00	8,665.87	2,171.47	176.40	291.79	225.92	13.50	49.85	13.50	160.36	25.00	204.94			
Virginia.....	15,000.00	8,226.60	1,824.63	1,746.17	1,079.14	98.77	100.38	37.46	29.00	228.30	25.75				
Washington.....	15,000.00	6,939.49	2,655.26	1,079.14	1,079.14	101.50	120.15	131.40	2.06	123.52	25.00	141.70			
West Virginia.....	15,000.00	11,496.64	1,201.75	25.00	75.72	70.73	49.67	215.99	100.94	409.11	413.18				
Wisconsin.....	15,000.00	7,975.00	2,955.00	561.68	13.20	629.10	99.72	446.40	409.11	409.11	409.11				
Wyoming.....	15,000.00	6,802.03	1,233.52	955.55	436.21	561.68	629.10	409.11	409.11	409.11	409.11				
Total.....	720,000.00	401,301.85	106,706.17	40,891.10	16,393.25	6,777.31	10,006.26	8,839.53	19,295.38						

TABLE 13.—*Expenditures from United States appropriation of March 2, 1887, for the agricultural experiment stations for the year ended June 30, 1911—Con.*

Stations.	Classified expenditures.										
	Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Live stock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
New Hampshire.....	\$363.16	\$256.11	\$471.19	\$54.81	\$522.18	\$268.33	\$11.00	\$443.77	\$25.00	\$42.82	.....
New Jersey.....	254.00	546.56	757.00	.85	264.79	702.51	543.55	.....	473.75	63.67	688.80
New Mexico.....	.....	.....	.....	.....	243.72	.....	.....	374.40	160.02	45.16	160.02
New York (State).....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
New York (Cornell).....	40.00	186.19	15.84	189.03	42.53	.....	.....	236.35	25.00	675.10	.....
North Carolina.....	892.27	1,689.21	134.13	679.39	137.22	4.55	609.65	408.49	29.00	273.22	.....
North Dakota.....	.....	.....	7.00	170.00	292.66	.....	19.30	25.00	176.64	.....	.....
Ohio.....	.....	333.95	44.79	103.40	35.75	8.05	.....	36.90	.....	669.64	.....
Oklahoma.....	420.13	737.83	800.48	302.09	126.43	30.90	40.04	2.00	128.45	25.00	728.87
Oregon.....	217.33	717.19	703.60	166.81	57.32	57.80	20.25	1.00	17.65	25.00	39.16
Pennsylvania.....	.....	.....	.....	.....	.....	.....	.....	459.57	25.00	433.51	.....
Rhode Island.....	370.11	756.75	223.89	250.22	183.02	6.85	304.00	249.87	2.00	745.88	.....
South Carolina.....	.....	808.59	168.79	106.81	418.72	588.59	.....	167.34	25.00	79.69	.....
South Dakota.....	371.01	704.58	278.53	81.03	116.25	.....	.....	80.25	25.00	456.18	.....
Tennessee.....	72.30	597.32	73.41	450.80	569.42	125.03	1,333.28	170.73	27.25	750.00	.....
Texas.....	114.71	513.96	100.63	235.41	66.40	18.31	54.00	524.33	70.00	212.38	.....
Utah.....	116.18	60.41	292.82	10.65	200.62	185.20	105.00	200.82	25.00	750.00	.....
Vermont.....	173.07	60.75	305.85	47.22	17.00	6.03	118.32	856.30	83.79	14.77	\$0.22
Virginia.....	10.38	206.33	44.92	168.60	290.19	.....	.....	1,251.25	32.75	183.90	.....
Washington.....	.....	204.86	585.27	24.50	45.00	214.97	.....	268.96	25.00	418.00	.....
West Virginia.....	67.85	2,457.39	147.99	147.64	148.20	447.91	206.13	423.67	25.00	153.82	.....
Wisconsin.....	80.97	1,739.85	30.70	493.08	50.83	95.72	251.65	251.65	25.00	.....	.....
Wyoming.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total.....	5,962.38	25,235.67	9,195.21	12,158.15	8,295.12	6,394.60	11,550.63	13,502.75	1,199.15	15,350.83	944.66

TABLE 14.—*Disbursements from the United States Treasury to the States and Territories for agricultural experiment stations under the acts of Congress approved March 2, 1887, and March 16, 1906.*

State or Territory.	Hatch Act.		Adams Act.	
	1888-1910	1911	1906-1910	1911
Alabama	\$344,199.34	\$15,000.00	\$41,619.89	\$15,000.00
Arizona	309,803.15	15,000.00	45,000.00	15,000.00
Arkansas	343,163.12	15,000.00	45,000.00	15,000.00
California	345,000.00	15,000.00	44,926.84	15,000.00
Colorado	344,963.24	14,755.58	44,756.22	13,882.71
Connecticut	345,000.00	15,000.00	45,000.00	15,000.00
Dakota Territory	56,250.00			
Delaware	344,332.87	15,000.00	42,050.12	15,000.00
Florida	344,966.11	15,000.00	44,996.19	15,000.00
Georgia	344,981.55	15,000.00	45,000.00	15,000.00
Idaho	270,000.00	14,824.13	42,117.93	13,724.29
Illinois	345,000.00	15,000.00	44,864.38	15,000.00
Indiana	344,901.19	15,000.00	40,000.00	15,000.00
Iowa	345,000.00	15,000.00	45,000.00	15,000.00
Kansas	345,000.00	15,000.00	45,000.00	15,000.00
Kentucky	344,996.57	15,000.00	45,000.00	15,000.00
Louisiana	345,000.00	15,000.00	45,000.00	15,000.00
Maine	344,999.62	15,000.00	45,000.00	15,000.00
Maryland	344,967.40	15,000.00	44,763.99	15,000.00
Massachusetts	344,617.70	15,000.00	45,000.00	15,000.00
Michigan	344,676.10	15,000.00	41,341.20	15,000.00
Minnesota	345,000.00	15,000.00	44,347.75	14,997.99
Mississippi	345,000.00	15,000.00	45,000.00	15,000.00
Missouri	340,097.24	15,000.00	45,000.00	15,000.00
Montana	255,000.00	15,000.00	42,417.04	15,000.00
Nebraska	344,932.16	15,000.00	45,000.00	15,000.00
Nevada	344,939.32	15,000.00	44,772.94	14,890.64
New Hampshire	345,000.00	15,000.00	45,000.00	15,000.00
New Jersey	344,961.97	15,000.00	45,000.00	14,558.78
New Mexico	209,998.90	15,000.00	45,000.00	15,000.00
New York	344,860.54	15,000.00	44,880.85	15,000.00
North Carolina	345,000.00	15,000.00	45,000.00	15,000.00
North Dakota	287,330.62	14,447.72	45,000.00	15,000.00
Ohio	345,000.00	15,000.00	43,514.02	15,000.00
Oklahoma	284,270.80	15,000.00	39,685.69	14,639.05
Oregon	331,631.82	13,524.82	40,000.00	15,000.00
Pennsylvania	344,967.43	15,000.00	44,995.41	15,000.00
Rhode Island	345,000.00	15,000.00	42,464.20	15,000.00
South Carolina	344,542.15	15,000.00	43,560.12	14,900.00
South Dakota	288,250.00	15,000.00	40,000.00	15,000.00
Tennessee	345,000.00	15,000.00	45,000.00	15,000.00
Texas	345,000.00	15,000.00	42,876.91	15,000.00
Utah	210,000.00	15,000.00	44,821.94	15,000.00
Vermont	345,000.00	15,000.00	45,000.00	15,000.00
Virginia	344,992.57	13,749.01	44,951.95	15,000.00
Washington	284,726.75	15,000.00	41,080.11	15,000.00
West Virginia	344,968.71	15,000.00	42,859.12	15,000.00
Wisconsin	345,000.00	15,000.00	45,000.00	15,000.00
Wyoming	330,000.00	15,000.00	45,000.00	15,000.00
Total	16,087,338.94	716,301.26	2,108,665.21	716,593.46

TABLE 15.—*Expenditures from United States appropriation of March 16, 1906,*

	Stations.	Amount of appro- priation.	Classified expenditures.						
			Salaries.	Labor.	Postage and station- ery.	Freight and express.	Heat, light, and water.	Chem- ical supplies.	Seeds, plants, and sundry supplies.
1	Alabama.....	\$15,000.00	\$8,209.36	\$1,315.24	\$177.86	\$281.29	\$198.02	\$691.15	\$414.34
2	Arizona.....	15,000.00	11,665.31	1,483.74	30.78	119.68	29.80	228.51	103.36
3	Arkansas.....	15,000.00	11,179.29	711.69	53.15	71.27	103.17	394.65	318.60
4	California.....	15,000.00	5,110.02	4,669.23	69.50	134.10	119.45	866.60	304.00
5	Colorado.....	15,000.00	10,491.34	597.45	133.45	243.50	.....	1,210.02	243.74
6	Connecticut (State).....	7,500.00	4,696.35	1,597.48	55.96	75.85	169.89	373.84	170.16
7	Connecticut (Storrs).....	7,500.00	4,954.44	975.40	26.76	3.15	298.37	178.81	878.12
8	Delaware.....	15,000.00	10,259.88	696.51	7.30	26.12	179.15	352.88	42.84
9	Florida.....	15,000.00	10,003.79	573.18	7.14	240.30	200.99	823.92	420.84
10	Georgia.....	15,000.00	9,499.45	1,491.58	131.92	117.87	320.34	199.22	667.61
11	Idaho.....	15,000.00	9,081.20	965.80	29.09	552.64	225.90	910.81	371.25
12	Illinois.....	15,000.00	8,828.03	3,875.08	122.60	121.23	.....	437.36	468.63
13	Indiana.....	15,000.00	11,450.00	47.55	20.02	61.61	.....	372.12	704.51
14	Iowa.....	15,000.00	9,307.50	2,615.26	26.96	104.78	.....	514.63	428.04
15	Kansas.....	15,000.00	5,619.19	4,409.25	26.71	195.57	62.90	732.01	455.75
16	Kentucky.....	15,000.00	11,249.99	172.25	39.65	.....	.....	510.20	85.05
17	Louisiana.....	15,000.00	9,707.79	507.71	24.51	62.60	520.02	457.07	56.98
18	Maine.....	15,000.00	13,927.11	98.05	.....	31.89	.....	.....	258.98
19	Maryland.....	15,000.00	11,354.30	182.67	2.33	2.36	149.07	537.94	103.43
20	Massachusetts.....	15,000.00	11,659.35	1,079.94	51.44	.....	170.47	137.54	356.20
21	Michigan.....	15,000.00	8,851.80	653.06	9.88	241.76	.....	1,405.00	346.15
22	Minnesota.....	15,000.00	12,339.94	1,270.03	67.00	.....	15	138.19	92.26
23	Mississippi.....	15,000.00	4,887.50	3,606.39	.65	204.10	96.82	158.33	1,371.77
24	Missouri.....	15,000.00	6,722.24	2,055.20	36.01	.....	28.21	2,424.89	713.86
25	Montana.....	15,000.00	9,942.50	1,141.38	80.09	225.84	7.00	907.25	197.02
26	Nebraska.....	15,000.00	8,502.50	2,576.62	46.37	88.52	.....	160.70	591.09
27	Nevada.....	15,000.00	9,600.87	392.85	12.70	86.96	.....	840.54	771.13
28	New Hampshire.....	15,000.00	9,461.03	2,549.25	50.10	46.83	7.98	297.54	551.98
29	New Jersey.....	15,000.00	9,118.32	1,321.98	73.64	31.56	145.32	696.77	644.95
30	New Mexico.....	15,000.00	10,485.60	1,297.04	40.00	325.70	246.76	187.11	544.41
31	New York (State).....	1,500.00	1,500.00	.....	.....	.....	.....	.....	.....
32	New York (Cornell).....	13,500.00	9,719.97	2,255.62	110.40	32.31	.....	405.97	314.71
33	North Carolina.....	15,000.00	10,656.98	1,129.28	183.22	108.22	37.20	466.21	113.49
34	North Dakota.....	15,000.00	10,139.62	1,541.67	48.36	13.40	.....	231.62	182.31
35	Ohio.....	15,000.00	11,080.95	976.08	.93	.....	.....	868.99	33.70
36	Oklahoma.....	15,000.00	7,462.68	2,365.60	22.79	221.35	133.82	513.28	343.27
37	Oregon.....	15,000.00	10,193.05	754.63	66.11	125.22	145.73	422.57	322.01
38	Pennsylvania.....	15,000.00	7,301.50	1,249.39	51.78	250.58	115.35	955.39	315.88
39	Rhode Island.....	15,000.00	8,774.18	3,295.71	118.88	127.75	290.52	101.20	245.32
40	South Carolina.....	15,000.00	7,266.67	2,967.91	121.72	47.34	66.94	270.48	354.52
41	South Dakota.....	15,000.00	5,871.55	4,170.81	108.75	749.06	94.32	883.02	1,019.03
42	Tennessee.....	15,000.00	9,875.00	529.66	9.40	92.61	157.38	465.94	302.69
43	Texas.....	15,000.00	9,165.89	1,265.95	7.36	256.11	176.51	1,673.02	251.34
44	Utah.....	15,000.00	6,620.86	4,146.26	48.55	46.30	316.65	347.40	222.78
45	Vermont.....	15,000.00	5,350.93	4,416.88	49.65	71.69	7.25	767.87	250.33
46	Virginia.....	15,000.00	8,814.07	1,563.99	66.47	150.64	63.45	286.08	666.52
47	Washington.....	15,000.00	8,783.09	2,554.35	5.60	248.03	41.75	317.35	269.66
48	West Virginia.....	15,000.00	9,638.27	1,394.00	3.05	.....	.....	51.86	34.16
49	Wisconsin.....	15,000.00	8,770.00	1,982.40	.....	.....	.....	1,080.86	1,413.07
50	Wyoming.....	15,000.00	8,549.68	215.83	30.34	213.79	38.00	769.23	166.54
	Total.....	720,000.00	443,700.97	83,704.88	2,506.93	6,451.63	4,964.50	28,714.94	19,507.38

for the agricultural experiment stations for the year ended June 30, 1911.

Classified expenditures—Continued.

Fertilizers.	Feeding stuffs.	Library.	Tools, implements, and machinery.	Furniture and fixtures.	Scientific apparatus.	Livestock.	Traveling expenses.	Contingent expenses.	Buildings and repairs.	Balances.
\$153.63	\$496.10	\$4.43	\$88.91	\$245.08	\$1,901.84	\$376.35	\$170.98	\$20.00	\$255.42	1
		8.75	124.89		323.00		456.95		425.23	2
7.00	391.14	75.08	376.07	87.28	142.41	103.85	236.68		748.67	3
	140.02	37.40	156.80	179.54	926.45	294.50	1,399.24		593.15	4
		103.49	224.70	38.00	951.13		566.75		196.43	5
109.98	58.55						11.00	115.94	65.00	6
	9.65	3.75	30.20	4.10	26.23	36.00	75.02			7
		7.76	29.00	1.50	74.80	3,282.14	9.93		30.19	8
82.70	56.03	121.17			1,150.21		830.25		489.48	9
	655.51	155.41	555.40	494.27	183.55	1,453.59	562.58	54.43	68.21	10
					146.00	240.19	305.03	27.35	25.52	11
	415.70						274.33	1,308.84		12
		123.07	3.40				297.95		336.60	13
			14.00			160.70		171.28	326.00	14
1,330.85	644.52	134.57	583.31	1,107.79	383.90	252.30	237.78	1.35	152.10	15
		343.50	201.00	508.75	1,830.61	29.00	30.00			16
	71.56	87.13	157.14	113.75	2,422.67	164.15	372.60	1.00	273.32	17
	23.17	58.12	12.88		336.45	51.00	158.52		43.83	18
870.00	267.49	61.87		233.29	128.78	340.00	29.31		737.16	19
75.27	1.46	7.53	4.50	50.00	1,343.17		18.13		45.60	20
	2.08	5.03	6.20	96.12	2,685.96	417.45	38.53		240.98	21
	6.34				66.91	175.65	61.10	50.42	54.78	22
	500.38	10.22	1,187.97	100.16	26.00	2,235.00	79.13		535.58	23
92.54	1,166.26				531.85	252.32	794.14	137.48	45.00	24
	410.92	120.64	481.48		162.81	46.44	115.45	1,027.33	133.85	25
	761.87		180.96	318.75	758.61	312.63	701.38			26
	178.60	91.19		34.70	931.93		273.35		750.00	1,035.18
51.34	712.35	34.74	12.38	3.00	325.21	111.10	374.92		410.25	28
254.00	240.00	275.55	228.08	419.00	1,143.52		20.09		387.22	29
6.55	230.21	46.06	664.32	25.80	182.71		64.20		653.53	30
										31
10.58	20.00	5.87	37.25	201.65	117.19		55.77		212.71	32
439.44	329.56	206.10	341.81	51.93	283.15	275.75	288.24		89.42	33
	466.53	88.05	125.30	127.25	652.68	659.50	47.70	30.00	646.01	34
		32.50		4.00	1,114.73		138.12		750.00	35
	1,261.71	375.13	115.45	72.00	937.10	159.72	108.60	157.50	750.00	36
	149.39	71.70	179.52	12.15	1,278.17	17.00	962.50		300.25	37
1,026.76		273.67	64.22	1,020.01	1,806.85		343.08		225.54	38
	38.03	834.16	3.60	417.37	47.80	250.01	252.30	177.85	25.32	39
341.12	822.89	401.79	289.32	8.00	185.59	1,300.52	150.55		304.64	40
50.10	441.20	28.00	233.80	145.15	203.33	600.00	106.53		295.35	41
		314.57	150.98	571.97	1,660.09		164.30		705.41	42
220.88	426.97	170.43	305.25	215.00	202.56	319.40	205.95		137.38	43
	578.41	17.71	650.99	32.64	1,400.35		367.25		203.85	44
	1,603.01	3.25	13.75	79.75	826.15	616.00	184.49		750.00	45
89.90	895.78	.56	10.32	126.00	136.60	500.00	203.33	9.95	52.07	1,364.27
		75.69		301.70	90.30	890.06	69.75	648.03	704.64	46
	1,362.41				1,766.25				750.00	47
2.62	1,187.97		174.70		270.40	100.00	17.98			49
	494.21	96.30	177.12	490.30	1,199.64	166.40	507.37		735.84	1,149.41
3,053.44	20,267.13	4,146.17	9,666.66	8,062.37	36,843.87	16,157.84	13,409.94	219.80	14,910.93	4,411.62

PROGRESS IN AGRICULTURAL EDUCATION, 1911.

By DICK J. CROSBY, *Specialist in Agricultural Education*, and C. H. LANE, *Assistant in Agricultural Education*.

SUMMARY FOR THE YEAR.

There is no longer any question as to the demand for instruction in agriculture in colleges, normal schools, high schools, and elementary schools. We read of it in the educational journals, the magazines, and the daily papers; we hear of it at conventions, on railway trains, and in street cars; and we find all of these agencies actively engaged in promoting agricultural education.

The educational demands upon the United States Department of Agriculture have increased enormously. The enrollment in boys' and girls' clubs conducted by the Bureau of Plant Industry increased from 46,000 in 1910 to 60,000 in 1911. The Division of Publications has sent out more than 27,000,000 copies of publications, but has found it impossible to comply with all of the requests from schools for publications to be used in agricultural classes. The Office of Experiment Stations, which officially represents the department in its relations with agricultural colleges and schools, has been favored with a larger measure than before of assistance in this work by the other bureaus of the department, but has found it impossible to keep pace with the demands made upon it.

Problems in agricultural education received a large share of attention at numerous national educational conventions, including the Association of American Agricultural Colleges and Experiment Stations, the National Education Association, the National Society for the Study of Education, and the Southern Educational Association. A new association, known as the American Association for the Advancement of Agricultural Teaching, was formed. The enrollment at the fourth session of the Graduate School of Agriculture was larger than at any previous session.

The agricultural colleges have received large biennial appropriations, some of which are among the largest ever given to educational institutions. The University of Illinois was given \$3,600,000; the University of Minnesota, \$1,283,900; the Kansas Agricultural College and station, \$985,000; the Oregon college and station, \$681,500; and the Washington college and station, \$485,000.

New secondary schools of agriculture have been established; 5 more States have provided State aid to encourage the establishment of departments of agriculture, home economics, and manual arts in pub-

lic high schools, making 11 that now give such aid; several States have increased their appropriations for secondary agricultural education; and hundreds of high schools have inaugurated work in agriculture without any special aid for the purpose. Upward of 2,000 secondary schools reported students in agriculture in 1911.

Details of the development and status of agricultural education will be found in the following pages.

EDUCATIONAL WORK OF THE DEPARTMENT OF AGRICULTURE.

The educational work of the department has been continued along the same general lines, but has grown considerably in extent. As in former years, the Office of Experiment Stations has represented the department in its relations with educational agencies, but several of the other bureaus and divisions have continued educational propaganda closely related to their respective lines of investigation.

The Bureau of Plant Industry cooperated with the Office of Experiment Stations in sending a representative to the Western and North-western States to investigate and report upon the teaching of agriculture in schools through the medium of school gardens. That bureau has continued and extended its club work with boys and girls in connection with the farmers' cooperative demonstration work in the South. The numbers enrolled in this work have increased from a small beginning four years ago until now the enrollment is practically 60,000. In his 1910 report the chief of the bureau comments on this work as follows:

During the season of 1910 the boys' corn clubs made a wonderful record. Many extraordinary yields were reported, largely due to the fact that the boys devoted their time and energy to a single acre. The 100 boys making the highest yields averaged 133.7 bushels of corn per acre on the 100 acres. In one county in Mississippi 48 boys averaged 92 bushels per acre. In a South Carolina county 142 boys averaged 62 bushels per acre. Prizes were donated by local people and obtained by general popular subscriptions. The leading prize in every State was a trip to Washington, given to the boy making the best record. A great deal of interest was aroused by the visit of these State prize winners to the city of Washington. They were presented with diplomas of merit by the Secretary of Agriculture, and much attention was paid to them by public officials and the people in general.

The effect of the boys' corn club work has been threefold: (1) It has materially assisted the department in bringing home to the southern farmer the fact that he can raise corn; (2) it has helped to break down prejudice in many communities against what is sometimes called "scientific farming;" and (3) it has also helped to give the boys an interest in farming and at the same time from its close connection with educational forces has been a powerful means of molding public sentiment regarding the teaching of agriculture in the schools, and especially in emphasizing the necessity for better rural education.

The work among girls has been started for the purpose of interesting them in the home life upon the farm. It seeks to show them how to raise a garden of vegetables, how to can the vegetables for market and for home use, and how to raise poultry at

a profit. The expenses of this work are paid entirely from the funds of the General Education Board, but the work itself relates directly to the problem of raising home supplies instead of purchasing them out of the cotton crop. This year more than 3,000 girls are engaged in this work and it is expected that next year there will be many more. Prizes similar to those offered in the boys' corn clubs have been subscribed by various public-spirited citizens. The enthusiasm with which the work has been taken up indicates a rapid growth and a large extension of interest in home gardening and the raising of poultry.

The Forest Service continued to cooperate with the Office of Experiment Stations in promoting the teaching of forestry in the public elementary and secondary schools. Under this cooperative arrangement two publications on the subject of forestry in school work were prepared and have since been issued as Farmers' Bulletins.

Courses in forestry were given at the Summer School of the South, University of Tennessee, and the Summer School of the University of Virginia, and lectures were delivered at the Summer School of the University of North Carolina, the Rural Life Conference of the Winthrop Normal and Industrial College, Rock Hill, S. C., and the Conference for Education in the South, Jacksonville, Fla.

An experimental course in forestry was conducted in connection with the agricultural course of the Agricultural High School of Baltimore County, Sparks, Md. This experiment is to be extended to other agricultural high schools during the calendar year 1912, and the information obtained will then be used as the basis for a publication.

The Office of Public Roads made numerous exhibitions and demonstrations at expositions and on educational trains. Twenty-two representatives of the office delivered 723 lectures in various parts of the country. The plan of appointing graduates in civil engineering from the leading engineering institutions in the country to the position of engineer student in the office has been continued. Concerning this feature of work the Director of the Office of Public Roads says in his report for 1911:

During the fiscal year 1911, 12 highway engineers resigned their positions in this office to accept service in connection with road work in various parts of the country. Of this number 8 were junior highway engineers, 3 were engineer students, and 1 occupied the position of highway engineer.

During the first year that engineer students are connected with the office they are given a thorough training in all branches of highway work, both in the field and in the laboratories, while at the same time their services are fully utilized by the office in laboratory and field work. At the end of the first year, if the students prove worthy and it is found that the needs of the service justify it, they are promoted to the position of junior highway engineer. At the close of the second year they are eligible for further promotion to the grade of highway engineer, and ultimately to the position of senior highway engineer.

This project has given excellent results, and the engineers after a few years' training in the office are in great demand for State and county work. The practice of permitting these engineers to resign is detrimental in one sense to the service, in that

the office is constantly losing some of its best men, but the benefits derived by the various States and counties through the distribution of trained men to all sections of the country are so great as to be a vindication of the wisdom of this project.

The editor in his annual report says that 27,594,877 copies of publications were issued. This was an increase of nearly 10 per cent in the number of copies printed and distributed as compared with the preceding year. The popular demand for the publications of the department was unprecedented, and it would have required at least 5,000,000 additional copies to have met this demand fully. Regarding the use of our publications by schools and universities he says:

The demand for the department's publications for use in schools of all grades and also from universities continues to increase and is far beyond our ability to supply. An effort is always made to furnish a limited number for this excellent use. Millions of publications, especially Farmers' Bulletins, could be placed in the hands of the youth of the country who are interested in agriculture and kindred subjects, and it is believed that such distribution of them would encourage agriculture and increase the prosperity of the Republic. An increase of the appropriation with this object in view is worthy of serious consideration.

The Bureau of Statistics, after conducting for three years, under the direction of the Assistant Secretary of Agriculture, an investigation of the practical workings of various types of consolidated rural schools in different parts of the United States, prepared and transmitted to the Office of Experiment Stations a valuable report on this subject, which has been published as a bulletin of the office under the title "Consolidated Rural Schools and the Organization of a County System."

EDUCATIONAL WORK OF THE OFFICE OF EXPERIMENT STATIONS.

The work of the Office of Experiment Stations in relation to agricultural colleges and schools has grown, but not sufficiently to keep pace with the development of agricultural education in the United States. There has been, as formerly, cooperation with and clearing-house work for colleges and schools of agriculture, conferences with those concerned with the inauguration of new agricultural-school projects, editorial and statistical work, and a large correspondence. In this work the specialist in agricultural education has been assisted by F. W. Howe, C. H. Lane, and B. B. Hare, assistants in agricultural education; Miss M. T. Spethmann, in charge of statistics and the review of foreign literature on agricultural education; and Miss M. A. Agnew, in charge of the card directory of teachers and investigators in agriculture and of the organization lists of agricultural colleges and experiment stations. Mr. Howe resigned October 15, 1910, to accept a more lucrative position with the New York State Department of Education and was succeeded April 16, 1911, by Mr. Lane.

Mr. Hare was appointed assistant in agricultural education and rural economics March 23, 1911, but during the remainder of the fiscal year devoted more of his time to rural economics than to agricultural education.

RELATION TO AMERICAN INSTITUTIONS.

In connection with the editorial work of the department of agricultural education in the Experiment Station Record, more than 1,700 foreign and about an equal number of American publications have been reviewed. In addition to the annual organization lists, statistics of agricultural colleges and experiment stations, review of progress in agricultural education, and lists of educational publications and institutions, there have been prepared and published special bulletins, circulars, and reprints concerning school exercises in plant production, school lessons on corn, agriculture as first-year science and community work in the rural high school, and an article dealing with county schools of agriculture and domestic economy in Wisconsin has been submitted for publication. In cooperation with the Forest Service a Farmers' Bulletin on Forest Nurseries for Schools was published, and a short course in forestry was conducted at the agricultural school of Baltimore County, Md. A contour map of the grounds of this school was also made, and with the assistance of the Bureau of Plant Industry a planting plan combining the elements of a botanic garden and an ornamental plantation was prepared.

Studies of American and foreign agricultural schools have been continued. The card index of foreign schools now contains over 6,500 cards, and that of American schools over 8,600 cards of institutions and 900 cards of teachers of agriculture. A list of American colleges and schools teaching home economics was prepared and published in the Journal of Home Economics. The card directory of American teachers and investigators in agriculture has been revised and now contains about 2,400 names. This directory is maintained for the convenience of agricultural colleges and other institutions seeking trained teachers and investigators.

Cooperation with the Association of American Agricultural Colleges and Experiment Stations has been continued. The director of this office has continued to act as bibliographer of the association, as chairman of its committees on instruction in agriculture, and on the history of agricultural education, and as dean of the Graduate School of Agriculture, the fifth session of which is to be held at the Michigan Agricultural College during July, 1912. The specialist in agricultural education helped to organize an association known as the American Association for the Advancement of Agricultural Teaching, which is referred to elsewhere in this review.

Numerous conferences and large agricultural gatherings have been attended, and at these and summer schools for teachers addresses on the work of the department have been given. In this work the agricultural education service of the office has been assisted by the Forest Service, the Bureau of Animal Industry, the Bureau of Plant Industry, and the Bureau of Soils. Such assistance is greatly appreciated by the people who ask for it, and it contributes materially to the advancement of agricultural education.

RELATION TO FOREIGN INSTITUTIONS.

AFRICA.

The three ways in which instruction in agriculture is being disseminated in Africa are by schools, fairs, and agricultural demonstration work. Two agricultural schools have been established recently in Gambia and Sierra Leone. Agricultural shows were held in the Gold Coast in 1909, and in Calabar in 1910.

ARGENTINA.

A consular report from South America announces the incorporation of the National Agronomic and Veterinary Institute of Argentina with the University of Buenos Aires at La Plata. Previous to this time there has been an agronomic and veterinary faculty in the university, and the consolidation with the institute, which was established in 1904, with the consequent strengthening of the teaching staff, is expected to produce a very complete course of instruction. The total attendance in the university now reaches 4,364, divided between the faculties of law and social science, philosophy and letters, medicine, and the physical and natural sciences.

AUSTRALIA.

The minister of agriculture of South Australia has practically completed arrangements for the establishment of a training farm for boys, not as a rival establishment to Roseworthy College, but to provide elementary education in agriculture for boys who sell newspapers and do odd jobs about the city streets, and who can not afford to go to college. It is believed that 12 months' training on the proposed farm will build them up physically, mentally, and morally, and give them sufficient experience to make them acceptable to farmers who need assistance on their farms. Board and lodging, clothing and boots, as may be decided upon, will be supplied in return for the labor of the boy. Premiums will be awarded to encourage boys to do well and to provide them with funds when they leave the institution.

BELGIUM.

It was the purpose of the organizers of the Brussels Exposition of 1910 to make it more than a demonstration of the industrial and commercial activity of the nations participating. With a view to giving it a permanent intellectual value, a series of congresses and conferences was provided for as one of the main groups of the exposition, which were held from April to October. There were some 69 of these congresses and a number of conferences, which had to do with a wide variety of subjects.

Among the congresses of special interest to students of agriculture may be mentioned the international congresses of horticulture, botany, tropical agronomy, entomology, popular education, agricultural associations and rural demography, apiculture, and alimentary hygiene, and the rational nutrition of man, as well as conferences which had to do with municipal sanitation and domestic architecture.

The Brussels congress of alimentary hygiene and the rational nutrition of man was the second international congress to be held, and like the first is due to the initiative of the French Société Scientifique d'Hygiène Alimentaire. The foreign countries invited to participate in this congress were asked to form organization committees, and Dr. H. W. Wiley, chief of the Bureau of Chemistry, acted as chairman of the American committee. Dr. C. F. Langworthy, who was chairman of the American subcommittee of section 1, biological physics and energetics, also supervised the collection of American papers on nutrition and other branches of home economics, and was in attendance at the congress.

In view of the interest and activity in human nutrition in this country, as evidenced by the work and the teachings of the federal department, the experiment stations, and the agricultural colleges, it seemed desirable that the American work along these lines should be adequately represented at the Brussels congress, and an effort was accordingly made to collect papers and other illustrative material.

The response from the teachers, investigators, and others concerned was quite general, although the time was short. Some 30 papers were received from the land-grant institutions, other colleges, normal schools, etc., in the United States, which give home economics courses.

These papers treated of such subjects as descriptive accounts of courses in home economics at the University of Wisconsin, University of Minnesota, Teachers College, and University of Illinois; the respiration calorimeter of this office and the work undertaken with it; the respiration calorimeter used in cooperative experiments at the Institute of Animal Nutrition, Pennsylvania State College; the American Home Economics Association and its work; a brief account

of the nutrition work of this office; and a summary of nutrition literature which has appeared in the United States since the previous congress.

In presenting the American work to the conference, Dr. Langworthy briefly outlined its scope, the agencies engaged in it, and discussed certain features of the findings and the general result of the movement. Prof. Paul de Vuyst, inspector of agriculture in Belgium, also spoke of the character and extent of this movement in the United States and paid attention particularly to the work in nutrition in the agricultural colleges and this department.

A collection of monographs published on the occasion of the twenty-fifth anniversary of the organization of the service of "agronomes" in Belgium contains an account of the organization of this service, the duties and qualifications of "agronomes," graduates of agricultural colleges engaged in extension work for the State, and the results obtained in the various provinces by their scientific and systematically organized work, as shown by increased yields in field and garden crops and fruits, the more extensive use of fertilizers and agricultural machinery, improvement of horses and live stock, in dairy methods, poultry culture, etc. The agencies employed to bring about these results are the teaching of agriculture in the primary schools, agricultural and special courses for adults, courses for farmers' wives, traveling agricultural domestic science and dairy schools, lectures, written and oral consultations, experiment and demonstration fields and gardens, farmers' institutes, women's institutes, agricultural librariés, associations, expositions, etc.

BRITISH ISLANDS.

Those who are familiar with agricultural development in this country under the stimulus of Federal legislation will find much of interest in plans which are now being formulated for the development of the economic resources of Great Britain through governmental aid. These plans are the result of a most comprehensive act of Parliament known as the development and road improvement funds act (Progress in Agricultural Education, 1910, p. 324), which although not restricted to agriculture seems likely to lead to far-reaching benefits to that industry.

Under the terms of the development act, as the measure is commonly known, there is provided a board of development commissioners, upon whose recommendations advances may be made by the treasury for aiding and developing agriculture and rural industries, forestry, the reclamation and drainage of lands, the general improvement of rural transportation, the construction and improvement of harbors and inland navigation, the development and improvement of

fisheries, "and for any other purpose calculated to promote the economic development of the United Kingdom." These advances may be either as grants or loans, and may be made to a government department, such as the board of agriculture and fisheries or the board of education, or to an educational or other public institution, or to an association of persons not trading for profit.

The funds available for the purpose consist primarily of what is known as the consolidated fund, for which the act appropriates the sum of \$2,500,000 annually for five years, beginning with April 1, 1910. To this may be added any special appropriations which may be made subsequently, or any gifts or legacies which may be forthcoming. The fund is available until used, and any revenue derived from such sources as interest or profits in the repayment of loans or the sale of farm products may also be utilized.

The development commissioners mentioned above constitute the administrative body in charge of the fund, and are eight in number, appointed by the King for terms of 10 years each, the tenure being so devised that the term of one member expires every two years. Two of the commissioners may receive salaries not to exceed \$15,000 a year each, and the board as a whole has the power of appointing subordinate officers at such salaries as it sees fit, subject to the consent of the treasury. It is authorized to appoint advisory committees in connection with the various projects taken up, and may also formulate schemes for new projects. The board of agriculture and fisheries has no part in the administration of the act, and by the law may itself be an applicant for grants under it.

The scope of the work which may be undertaken with this act is very comprehensive. The term "agriculture and rural industries" as used in the act is subsequently defined as including agriculture, horticulture, dairying, the breeding of horses, cattle, and other live stock, the cultivation and preparation of flax, the cultivation and manufacture of tobacco, and any industries immediately connected with or subservient to any of these. The lines of development open are also enumerated, as the "promoting of scientific research, instruction, and experiments in the science, methods, and practice of agriculture (including the provision of farm institutes), the organization of cooperation, instruction in marketing produce, and the extension of the provision of small holdings; and the adoption of any other means which appear calculated to develop agriculture and rural industries." Forestry work, likewise, may include experiments, the teaching of methods of afforestation, and the actual purchase and planting of land.

Road improvement is specifically dealt with in a separate section of the act. This provides for the appointment by the treasury of a road board entirely distinct from the development commissioners. No

funds are directly appropriated for road improvement in the development act, but provision is made for borrowing money from the consolidated fund or from any other available source, the sums borrowed to be repaid from the road-improvement grant, obligation for interest and refund not to be incurred beyond \$1,000,000 for any one year. The revenue of this board for the present year has been stated at about \$1,500,000, with a prospect for a considerably larger amount next year.

This summary of the provisions of the act as a whole will make it evident that wide discretionary powers are vested in the development commissioners, and that the results attained will be largely influenced by their decisions as regards the lines of work to be entered upon and the way in which these are to be conducted. The commissioners have thus far devoted themselves largely to formulating carefully considered plans. As would be expected, keen interest has been manifested in the possibilities afforded by the act, and applications for aid under its provisions have been so numerous as to lead to a statement some months ago that the grants then asked for would involve an expenditure of three times the sum available.

Although the act became law December 3, 1909, only one project has been given formal approval. This has for its object the encouragement of light horse breeding, a matter of particular importance in Great Britain at present because of the requirements of the British Army, now largely met by importations of foreign stock. A grant of \$200,000 has been made for the ensuing year, which it is planned to utilize in the award of premiums to stallions, grants for the purchase of grade mares, the free nominations of mares for service by premium or approved stallions, the purchase of thoroughbred stallions, and the encouragement of voluntary stallion registration. The detailed expenditure of the funds is to be intrusted to an advisory committee representing the various interests most concerned.

The utilization of a portion of the fund for agricultural instruction and research has not yet been definitely provided for, but is understood to be receiving much consideration. The desirability of such aid seems to be generally conceded, particularly as at present the treasury funds available for these purposes are comparatively restricted. Grants to higher education in agriculture have been made for many years by the board of agriculture and fisheries, which corresponds in a general way to the Federal Department of Agriculture in this country, but for 1909-10 these amounted to but \$61,500, distributed among 20 institutions. In 1908-9 additional special grants for experimentation and research were begun, but these also have been small, ranging in 1909-10 from \$125 to \$1,000 each, and aggregating but \$3,000.

The need for additional resources for these purposes has long been felt, and has been a frequent subject for discussion not only among agricultural workers, but also by scientific men in general. Last October the board of agriculture and fisheries made application to the development commissioners for \$200,000 annually for use in research work in agriculture and for giving technical advice to farmers. A number of agricultural colleges and similar institutions have submitted independent applications for financial aid, and the local county councils, which at present receive small grants from the board of education for elementary instruction in agriculture, have requested that \$10,000 be set aside for the employment of county agricultural advisers.

There has also been presented to the prime minister for reference to the commissioners a report from the British Science Guild, dealing with the present position of agricultural research in the United Kingdom, together with a memorial signed by members of Parliament, representatives of societies connected with agriculture, and persons prominent in the scientific world. This memorial declares that "only by a liberal allotment of the funds now available can British farmers be placed in the positions enjoyed by their competitors in other lands, where the endowment of agricultural research has long been recognized to an extent to which there is no parallel in Great Britain as among the most urgent and legitimate objects for State aid."

The immediate investigation of the large questions raised by these applications has been intrusted to a subcommittee of the commissioners, consisting of Prof. A. D. Hall, of the Rothamsted experiment station, and Mr. Sydney Webb. This subcommittee is conferring with an advisory committee of 15, appointed by the board of agriculture and fisheries, of which Secretary T. H. Middleton, of the board, is chairman, and it is expected that a comprehensive policy will be evolved.

The advisory committee of 15, above mentioned, has to do with all scientific questions bearing directly on the improvement of agriculture, and especially as to methods to be adopted for promoting agricultural research in universities and other scientific schools, aiding scientific research workers, and insuring that new scientific discoveries are utilized for the benefit of agriculture. A rural education conference of 42 members has been recently constituted by the presidents of the board of agriculture and fisheries and the board of education for the discussion of all questions connected with education in rural districts and those of interest to agriculturists and the two boards. Hon. Henry Hobhouse is chairman of this conference, which includes among other members Maj. P. G. Craigie, A. D. Hall, William Somerville, and T. B. Wood.

A poultry demonstration train, fitted up with improved poultry appliances and other illustrative material, was recently sent out for 8 days in Wales. Lectures and demonstrations were given along the route, the advantages of cooperation in marketing receiving particular emphasis. The train is believed to have been the first of the sort in Great Britain, but it is reported that it was very favorably received and that the plan will be given an extended trial in other sections.

BRITISH WEST INDIES.

A farm school has been established at Hope Gardens, Kingston, to give boys of about 15 years of age as complete a training as possible in all branches of practical tropical agriculture. The course will extend through three years and lead to a certificate. The school opened January 25, 1910.

CANADA.

An act of the recent legislature of British Columbia sets aside 170 acres at Point Grey, a Vancouver suburb, for the site of a provincial university, and makes a grant of 2,000,000 acres of public lands for its maintenance. Plans are being formulated for the erection of over 30 buildings. One important group is to be provided for a college of agriculture, with accompanying schools of forestry, domestic science, and veterinary science. A central farm in connection with the college is proposed, as well as several branch farms in the Province.

The annual report of the Ontario Agricultural and Experimental Union for 1909 contained the first annual report of the schools' division of the union. At last year's meeting of the union there was appointed a schools' committee, composed of Prof. S. B. McCready, director; Prof. H. L. Hutt, secretary; Profs. C. A. Zavitz and E. J. Zavitz and Mr. E. A. Howes, representatives on agriculture, forestry, and school gardening, respectively. The work was divided into a children's gardening section and a schools' experiment section. In the former the union offered to sell 1-cent seed packets to children for their home or school garden plats, and in the latter teachers were offered seed free for four observation plats either in the school ground or adjoining fields, including a plat in agriculture to show the seven different species of wheat, in forestry to show different maples, in horticulture to show the different kinds of onions, and in floriculture to show different kinds of nasturtiums. Applications were received from 116 schools for the children's seeds and more than 12,000 seed packets were sent out. To make the work uniform throughout the Province, a definite allotment of seeds was made for each grade in public-school work. The packets were accompanied by a book of instructions and a blank form for the teacher's report on the work in

the fall. The 56 reports received were quite satisfactory. Twenty-two schools made application for the teachers' experimental material, which was accompanied by instructions for conducting the work and outlining a course of instruction in elementary agriculture through lessons based on the pupils' practical work. Six schools have reported satisfactory experiments, several noting an improvement in the school spirit and discipline.

CENTRAL AMERICA.

Consul A. T. Haeberle, of Tegucigalpa, announced that an agricultural school has been established in the Episcopal Palace at Siguatepeque, in the Republic of Honduras, under the direction of H. A. Owen, an American. The municipality gave 130 acres, and 50 acres and buildings have been leased, making altogether 180 acres at the disposal of the school.

There will be on the farm a sufficient number of cattle and horses and the boys will be taught to handle modern farm implements. Foodstuffs will be raised for the consumption of the school and experiments will be made with different grasses and wheat. It is stated that a number of people in the United States are interested in the school, and that several men of practical experience have offered their services, among others a wealthy cattleman who intends to send cattle for breeding purposes.

FRANCE.

The course of study in the agricultural institute recently annexed to the faculty of sciences of the University of Toulouse extends through two years, leads to the diploma of agriculture, and includes theoretical and practical instruction in the following subjects: General agriculture, agricultural botany, agricultural chemistry, agricultural engineering, rural economy, geology, agricultural zoology, and animal breeding. In addition there is a series of weekly lectures on horticulture, silviculture, viticulture and enology, rural architecture, agricultural hydraulics, agricultural hygiene, meteorology, apiculture, etc.

A monument was erected at the National School of Agriculture, Montpellier, in recognition of the work of the late Gustave Foëx, a former president of the school, in improving the culture of grapes in Europe. The monument was erected by a popular subscription of about \$3,000, contributed by people of France, Austria, Italy, Egypt, and Greece, and symbolizes the encouragement rendered to European grape culture by the introduction of American grapes. The dedication of the monument is to take place this spring.

GERMANY.

The following statistics are some indication of the development of agricultural education in Prussia: From 1881-1907 the total appropriations for the Berlin High School and the Bonn-Poppelsdorf Academy increased from \$59,032 to \$107,308, an increase of 81.8 per cent; for the university institutes, from \$31,335 to \$52,751 (not including salaries of professors), or 68.3 per cent; for the other institutions (including the Kaiser-Wilhelm's Institute) from \$90,367 to \$204,441, or 126.2 per cent.

In the agricultural intermediate schools, of which there are 18, the total attendance from 1880-1908 has more than doubled, but the number of pupils coming from farms has not increased at the same rate. These schools are aided by the State, but are not State schools.

The lower agricultural institutions give special training to farmers' sons and disseminate a knowledge of the progress of technical agriculture. They comprise farm and winter schools, the former offering a theoretical or theoretical-practical course of from one and one-half to two years as a preparation for practical farming, while the winter schools are practical schools in continuation of the instruction given at the public and continuation schools. They consist usually of two winter courses of from five to six months each, and are intended for farmers' sons who are employed on farms during the summer months. A comparison of these two classes of schools shows the popularity of the winter schools over the farm schools. The number of farm schools decreased from 1875-76 to 1908-9 from 26 to 17, and the number of winter schools during the same period increased from 12 to 184. This increase in winter schools over farm schools is due to a large extent to lower expenses, less interference to farm work, etc. While the number of farm schools decreased one-third in the period mentioned, the attendance at the present schools has been doubled, from which it would appear that the discontinuance of the smaller practical-theoretical schools has led to a larger attendance at the larger and more purely theoretical farm schools. The average attendance of the 12 winter schools in 1875-76 was 13, while that of the 184 winter schools in 1908-9 was 39.

The minister of agriculture decreed that beginning April 1, 1911, all candidates for appointment as itinerant agricultural instructors must have satisfactorily completed two semesters of work at a normal training school. A year ago a similar qualification was required of candidates for teachers of agricultural schools and State-aided farm and winter schools. With the introduction of the training school at the agricultural school at Eldena there are now three of these training schools in Germany. They receive aid from the State toward the payment of teachers' salaries and maintenance. The ministry of agriculture decides as to the efficiency of candidates for appointment.

For a number of years the viticultural school at Weinsberg, Germany, has given courses in fruit utilization for women and girls. Owing to the overcrowded condition of these courses similar courses have been established and a new building erected for the purpose at the Pomological Institute, Reutlinger. Five courses, covering one week each, were held during July and September, 1909, to each of which 20 students were admitted. The student's time is employed each day in the week (1) in attending lectures on the utilization and preservation of foodstuffs, especially fruits and vegetables, and on the action of bacteria, the sterilization of fruit, and related subjects, and (2) in the actual work of preserving, sterilizing, pickling, drying, harvesting, sorting, packing, and shipping fruits and vegetables. The students provide the fruit and vegetables and at the close of the course have a good supply of conserves, jellies, and marmalades as a result of their efforts.

INDIA.

The Government of India, with the concurrence of the local governments of that country, accepted the proposal of the board of agriculture that graduates of colleges of agriculture in India be given the degree of licentiate of agriculture. This agricultural degree will be recognized in all official publications, and it may be advisable eventually to recognize it as equivalent to a B. S. or B. A. degree as a qualification for government appointments. It is, however, left to each local government to decide what government positions shall be open to candidates with the licentiate of agriculture degree.

The local governments also agreed to adopt, with necessary local modifications, the standard three-year curriculum prepared by the board of agriculture, and to maintain practically uniform admission requirements and final examinations of uniform grade of difficulty.

Regarding the affiliation of agricultural colleges with provincial universities, the Government of India does not consider such affiliation necessary at the present time, but thinks it preferable that each college be controlled by the director of agriculture with the advice of the director of public instruction. All local governments have agreed to this with the exception of Bombay, where the Poona College of Science has long been affiliated with Bombay University for the purpose of examination for the L. Agr. degree, and with the full concurrence of the central government this satisfactory arrangement will be continued.

MEXICO.

A recent law provides for the establishment of national agricultural boards, the object of which is to develop agriculture, and especially stock raising, forestry, and related industries. They will encourage the holding of agricultural expositions and will keep in touch with

domestic and foreign boards of the same class. One feature of their work will be the publication of reports for the information and instruction of agriculturists, the awarding of prizes for treatises on agriculture, the establishment of agricultural schools, and the creating of scholarships to aid in the study of agriculture.

NEW ZEALAND.

A two-year secondary course in agriculture and dairying has been introduced into the district high schools of Wanganui. The subjects of study include physics, chemistry, physical geography, botany, plant life and growth, entomology, work in the garden, manures and manuring, drainage, animal life, dairying, and economics. As a third-year course pupils may be required to conduct experiments under the supervision of the teachers. This course has been outlined with a view to the development of nature study, practical geography, agriculture, dairying, and weather studies of the primary school; the development of scientific method by the processes of observation, experiment, and inference; the making of each year's course complete in itself, the preparation of the pupil for the junior civil service, or the matriculation examination by the end of the second year; and the general development of the pupil.

RUSSIA.

As an indication of the progressive policy adopted by Russia along agricultural lines, it may be cited that at the Imperial Agricultural Museum at St. Petersburg there has been conducted gratis, for the last few years, a series of systematic readings on agriculture for the benefit of everyone interested. Popular lectures are also delivered and special readings conducted for men in the lower ranks of the army. In the experimental department of the museum demonstrations are given, by trained mechanics, in taking apart and putting together various machines and in operating agricultural machinery; the use of agricultural implements is explained, and experiments are made with all classes of farm machinery, such as locomobiles, fanning mills, graders, etc. In separate departments are demonstrated the fertilization of fish spawn and the development of the chicken in the incubator. The attendance at these lectures, which are delivered in the evening from 7 to 9 and on Sunday from 2 to 3 p. m., has increased from year to year. In 1906 it was 5,093; in 1907, 17,808; in 1908, 32,442; and in 1909, 60,346. Practical work and excursions to exhibitions and farms in the suburbs, stockyards, and slaughterhouses are arranged between lecturers and students. Likewise the special classes pass through practically everything pertaining to plant culture, stock and poultry raising, bee culture, and dairy farm-

ing, including butter and cheese making, etc. In the first half of the present scholastic season, beginning in October, 1910, the courses of systematic lectures will embrace the following subjects: Elementary chemistry, elementary anatomy, physiology of plants, improvement and cultivation of the soil, agricultural meteorology, agricultural economy, seeds, agricultural implements, cattle and swine raising, etc.

SWEDEN.

A school for training teachers of domestic science, with special regard to the demands of the country, was organized by the Fredrika Bremer Society, a large woman's association, in the autumn of 1907. To accustom students to the conditions prevailing at small farmer homes a farm of such size as may be regarded normal for a small farmer family in Sweden is connected with the school. All the students live in the schoolhouse, which will accommodate 20 students, and there receive theoretical instruction as well as practice in cooking, tidying-up, dishwashing, baking, preserving, washing, and all other kinds of home work. The students are divided into five classes, and each class spends a fortnight in each department of the school. During six months in summer housewife pupils work at the school and are taught in part by the teacher students, who thus acquire practice in teaching, are relieved in part of the practical work in which they have attained proficiency, and thus have more time for gardening. The theoretical instruction includes science of nutrition, food, chemistry, physics, botany (cultivated plants); physiology, hygiene, children's nursing, bookkeeping, household budgets, etc., dairy work, gardening, and agronomy. A high-school course is desirable for admission to the school as a teacher student, but is not insisted upon. For its establishment the school received \$670 from the Government, \$1,045 from the royal agricultural societies, as well as some money from private persons. The Government also makes an annual appropriation of \$1,072 to the school. The teacher students pay \$160 a year and the housewife pupils \$8 a month. The staff consists of a principal and four teachers, and extra teachers give lessons in some branches. The regular course prepares students to become teachers in permanent and itinerant cooking classes and in farming schools in the country.

EDUCATIONAL WORK OF THE ASSOCIATION OF AMERICAN AGRICULTURAL COLLEGES AND EXPERIMENT STATIONS.

The twenty-fourth annual convention of the Association of American Agricultural Colleges and Experiment Stations was held at Washington, D. C., November 16-18, 1910. A varied and interesting

program of papers, addresses, and reports bearing upon the organization and administration of college, station, and extension work was presented.

President W. J. Kerr, of the Oregon Agricultural College, who presided, set forth in a forceful address the substantial progress and creditable achievements of the agricultural colleges in the face of very great difficulties, and vigorously refuted recent criticisms of the work and position of these institutions.

President J. K. Patterson, of Kentucky, in an eloquent and scholarly address, presented in retrospect the industrial development and the progress in industrial education during the past 50 years.

Capt. M. J. Lenihan, as the representative of the War Department, presented a paper in which he discussed the relations of that department to the land-grant colleges, and emphasized the value of military instruction to the student, to the college, and to the Nation.

Dr. A. C. True, in his report as bibliographer, dealt with agencies and methods now employed in the publication of the results of scientific research under official, semiofficial, and private auspices.

The report of the committee on graduate study, presented by H. P. Armsby, chairman, dealt mainly with the Graduate School of Agriculture held at the Iowa State College July 4-29, a report of which was presented by A. C. True, dean of the school. By increasing the annual dues of each college represented in the association to \$50, the association made more definite and adequate provision for the maintenance of this school. The committee recommended that the fifth graduate school be held in 1912. In the committee's opinion the graduate school, by stimulating advanced study, will make it necessary for the agricultural colleges to differentiate more clearly between undergraduate and postgraduate work, and to provide more adequately for the latter. The committee has therefore undertaken to aid the United States Bureau of Education in its inquiry into the facilities for postgraduate work at the land-grant colleges.

Commissioner E. E. Brown, K. C. Babcock, and A. C. Monahan, of the United States Bureau of Education, explained to the convention the character of the new work in the field of higher education, especially as related to the land-grant colleges, which the bureau proposes to take up under authority recently granted by Congress, and asked for the cooperation of the association in this work. One of the first lines to be entered upon is an inquiry into facilities for graduate study at land-grant colleges. A resolution approving the proposed work and favoring the enlargement of the Bureau of Education was adopted.

The report of the committee on instruction in agriculture, presented by A. C. True, chairman, outlined a college course in home economics,

and stated that a secondary course in animal production was in press and would be issued as a circular of this office.¹

The discussion of questions relating to the organizing and conducting of extension work in agriculture was a prominent feature of the convention. The report of the committee on extension work, presented by K. L. Butterfield, chairman, was devoted to a discussion of the problems confronting extension work in agricultural colleges, notably those dealing with the need of largely increased funds for the purpose and the source from which these should be derived, definitions and nomenclature relating to extension work, the types of work to be undertaken, the forms of administrative organization, the training requisite for workers, and the problem of social leadership. As a supplement to the report, detailed data compiled by John Hamilton, of this office, as to the present status of extension work in the United States, were submitted. These showed that 32 States and Territories now have complete or partially complete organizations for the purpose, and that the revenue in 29 States for the fiscal year ended June 30, 1910, aggregated \$447,110.92. With reference to the method of organization, the committee favored in general the plan whereby the work is performed by a director or superintendent of extension work, responsible directly to the head of the agricultural work of the institution, and a corps of workers made up in part of men giving practically all their time to extension teaching and in part of the regular college and station staff.

A round-table conference, led by W. E. Stone and A. M. Soule, on national aid to extension work and secondary vocational education, followed the presentation of the report. After earnest discussion of the matter, the association reaffirmed its approval of national aid to extension work and requested the executive committee to use all legitimate means to secure such aid, but declined to make any formal expression of views regarding pending legislation providing for national aid to secondary vocational education. Later, however, this matter was referred to the newly established standing committee on college organization and policy for investigation and report at the next convention.

The question of the agricultural colleges charging a fee to nonresident students was discussed at one session of the convention, and a diversity of practice in this respect was developed. Chancellor Samuel Avery, of Nebraska, thought no fee should be charged. President Stone, of Indiana, and Dean Russell, of Wisconsin, agreed with this position in theory, but thought a fee necessary to equalize burdens between resident and nonresident students and to protect the college. Apparently foreign students are not as a rule charged a fee by the institutions represented in the association.

¹ U. S. Dept. Agr., Office Expt. Stas. Circ. 100.

Dr. True submitted a brief report of progress from the committee having the history of agricultural education in charge, and the committee was again continued.

In the section on college work and administration the four topics discussed were entrance requirements to college courses, correlation of secondary and short courses with the four years' course, a plan of university organization, and the administrative relations between the board of trustees, the college president, and the dean and director.

The first topic was discussed in a paper by H. J. Waters, who believed that as far as the quantity of the work required—the number of units for college entrance—the land-grant colleges should follow the lead of other colleges, but as to the kind of work he would recommend a change. He pointed out that the college preparatory work now demanded is a serious burden on the country high school, owing to the increasing demand upon these schools for more practical courses—greater attention to agriculture, domestic science, and manual arts; and he recommended that the land-grant colleges offer liberal credits to vocational subjects for entrance to any college course. Consideration should be given, not only to the college courses, but also to the needs of the pupils in schools below college grade. For this reason courses should be encouraged in the seventh and eighth grades of the elementary schools, and in the first two years of the high school to prepare pupils for life work.

D. H. Hill thought it is not entirely a question of what preparation the college would like to have its entering pupils receive, but what the high schools are prepared to do. He believed that for a time the colleges must accept an approximation of what might be considered the ideal college entrance preparation, and that possibly it might be well to admit students to the agricultural courses on a lower basis than to the engineering and other more technical courses, owing to the fact that the country schools are not as well prepared to give college entrance work as the city schools, and to his belief that young men coming from the country are able to work harder than those coming from the city and thus to reach the bachelor's degree standard in four years even if they start with a lower grade than do the city boys.

The paper was further discussed by Brown Ayres, who emphasized the desirability of getting students for the agricultural courses from classical preparatory schools; by W. M. Hays, who referred to the influence of the consolidated school in keeping students in school longer and thus giving them a greater amount of classical work; by Howard Edwards, who had found it desirable to give college credits for some high-school work in cases where students were able to present surplus units in one line of work and were deficient in others; and by A. R. Hill, who believed that when a young man is able to do

college work he should be admitted without much reference to formal credits. President Hill also called attention to the fact that it is difficult to get high schools to present more than one year of well-taught agriculture for college entrance, and suggested that the agricultural colleges could aid the movement for the better teaching of agriculture in secondary schools by preparing outlines and helping to standardize the work in such schools.

A discussion of the correlation of secondary and short courses with the four years' course was presented in a paper by D. J. Crosby, who pointed out the fact that these courses were established primarily to prepare young men for the business of farming and not for college entrance, but maintained that in all such courses opportunities for college entrance preparation should be afforded to students having the ambition, the intellectual qualifications, and the means to pursue a college course. For such students, he maintained, there should be no gap between the end of the secondary or short course and the college course, such as is found in schools offering a three-year severely technical agricultural course and an intermediate year of academic work for college entrance. He maintained also that schools having a six-months year should endeavor to provide their students with summer-vacation problems to be worked out on the farm, to be regularly reported upon at the opening of the succeeding year, and to receive definite credits toward graduation. This would have the effect of standardizing work which is now done and for which there are no definite credits, and by reason of which the school suffers in comparison with other schools in presenting college entrance credits.

In his discussion of this paper, H. C. Price dealt with the public-school secondary courses rather than the secondary schools maintained in connection with agricultural colleges, and stated that in the Ohio College of Agriculture it was the practice to make it more difficult for city boys to enter the college course than for country boys, this being accomplished by admitting country boys upon graduation from a three-year high-school course, while city boys coming from a four-year high-school course must present a certificate of graduation. He said that judging from three years' experience the college of agriculture had not suffered from such an arrangement. The purpose of the short courses in the college of agriculture, according to Dean Price, is to prepare for the business of farming, and such courses should not be combined with college preparatory courses.

W. M. Hays referred to the desirability of maintaining secondary courses, for a time at least, in every agricultural college to aid in the preparation of teachers of agriculture for lower schools.

A plan of university organization was discussed informally by A. R. Hill, who recommended (1) a small board of control, 7 to 9 members, to be appointed by the governor from both political parties, whose

function should be to confirm the recommendations of the faculty and to lay down general rules under which the faculty may act freely; (2) a faculty consisting of a university faculty to pass legislation for all departments, special faculties of agriculture, law, medicine, etc., to have charge of admission, courses of study and regulations for graduation for their respective colleges, and a junior college faculty, the latter to consist of teachers of general courses for freshman and sophomore years; (3) in State universities an experiment station staff; and (4) an extension staff with a permanent director and special faculty working as members of the different departments in the university. No graduate faculty should be provided for, such being an anomaly in a true university.

Dean Davenport discussed the administrative relations between the board of trustees, the college president, and the dean and director. He stated two theories with reference to the origin of authority in educational institutions, (1) that it is derived from one's immediate superior, and (2) that authority goes with ability and responsibility. He believed that the best organization includes a board of trustees to serve as a legislative body dealing largely with principles and little with details, and keeping the institution in close touch with public demands. The board should be a legislative body and should not be concerned with the execution of its laws.

The president of the college, being the highest executive officer of the institution, should be a strong man and should be made responsible for the execution of the regulations laid down by the board. He should be a clearing house of university affairs and the only official avenue of communication between the employees and the board, and in fulfilling this function should deal with each department as an administrative unit. The department, however, should not be the unit of work; the individual is the unit of work; and in small institutions there need be no intervening officer between the president and the corps of workers. If, however, the institution is large enough to be organized into colleges there should be not only departmental organization but departmental groups, presided over by deans or directors who should function as administrative clearing houses between the president and the heads of departments.

The sessions of the new section on extension work provided by the association at its last convention were of much interest, in view of the present activity in extension work and the many problems it presents as to organization, methods, etc.

The present status of agricultural extension was discussed in a paper by K. L. Butterfield. It was shown that 35 colleges and experiment stations, representing 32 States and Territories, have now organized for agricultural extension work, the oldest dating back only to 1901 and only 5 extending back beyond 1906. There are

now 113 persons regularly employed for the sole purpose of agricultural extension work.

The form or type of organization differs greatly in different States, and in some there is as yet no organization, the work being carried on by different members of the college or station staff independently of one another, and with no central coordinating or unifying control.

No common type of organization for extension work seems at present feasible in the several States, but the general consensus of opinion favors an organization which will be coordinate with interior instruction and research, and which will at the same time recognize and maintain departmental integrity in the institution as based on subject matter.

John Hamilton, of this office, in continuing the discussion of this subject, showed the need of systematic methods of procedure in successful and permanent extension teaching, outlined the numerous activities involved, indicated a system of procedure embracing the complete organization of extension teaching, mapped out the field of work, gave the present financial resources for this activity in the United States, and spoke of the need of Federal appropriation. In 1910 there was appropriated by 25 States the sum of \$286,950 for agricultural education extension, while receipts from other sources brought the total up to \$447,110.92.

H. L. Russell emphasized the need of a clarification of the principles of organization in extension work, and supported the plan which correlates the extension work with that of research and interior teaching, and at the same time preserves departmental integrity. Some form of demonstration was conceded to be the best plan for reaching the persons most in need of assistance.

The subject of extension schools was presented by E. A. Burnett, who held that the movable school is capable of adapting itself to a variety of conditions, and is especially applicable to the needs of advanced rural communities where a high order of systematic instruction is needed, or where special industries are being developed. It should be a real, serious school, and not a vaudeville meeting with a large enrollment as a factor to attain; and the time and place of holding the school should be in keeping with the subject under discussion in the region concerned. This latter is of great importance, since a large part of the work of such schools should be field and demonstration work, and this must be conducted at the proper time and place for such work in regular farm practice.

T. A. Hoverstad called attention to the difficulty of getting farmers to believe thoroughly in the practicability of a demonstration conducted on station property, which difficulty was entirely removed by having the demonstration conducted on private farms, under the direction only of the station.

G. I. Christie maintained that movable schools, or short courses out over the State, are to be laid out according to local conditions in each State, and stated that in Indiana they are arranged according to districts.

That the good farmer will take care of himself, and that therefore efforts should be directed to the indifferent farmer, was brought out by C. H. Hinman, who also emphasized the value of demonstration farms in extension work, and the necessity of following up and keeping in touch with each individual.

If extension work in agriculture is to be of lasting and permanent good and result in a better agriculture and rural life, then it must be measured by the number of farmers who adopt improved methods as a result of this propaganda, and not by the mere number of persons attending an extension meeting which may be ever so interesting and popular and attract large crowds and still result in little or no change or improvement in farm practice in the region in which the meeting is held. A small number of persons permanently benefited in a large number of places is far better than a large number of persons in a few localities, even though equally benefited, because of the examples these people set in their communities.

The necessity of following up the extension work constantly, as a means of making it effective in its results, was emphasized by K. L. Hatch.

P. G. Holden pleaded for generosity and leniency toward one another's plan, especially in this plastic, formative stage of extension work, the differences being explained by the very different conditions in which each one is working; and he suggested the formation of a graduate school for instruction in extension work.

The training and preparation of extension teachers was outlined by A. C. True, of this office. Two divisions in the personnel were recognized, (1) the practical farmer who has made on the farm a success of some particular phase of agriculture and has developed a special ability as speaker and as writer, and (2) the college man whose scientific knowledge enables him to attack intelligently certain farm problems, and who shows ability to interest and instruct farmers through extension work. A combination of these two in one man would make the ideal extension instructor. As a training for extension teaching the practical farmer should pursue carefully planned reading courses and short courses in an agricultural college, and visit other regions; and the college man should devote a proportionate amount of time to actual farm practice. The summer vacation could be devoted to this purpose. The training of the younger generation for extension teaching should include, besides the regular college of agriculture courses, a year of postgraduate work in the extension department and a year of actual farm practice. The necessity for

the extension man to be a true teacher and not an entertainer was emphasized. He should study the special needs of each community and visit a wide range of regions. Importance was also placed on studying the art of public speaking as well as pedagogics.

W. H. French maintained that agricultural extension is a part of our public education and should not be regarded or used as a means of advertising the college. The establishment of a system of consolidated rural schools, township high schools, and the introduction of agricultural courses in these and in the high schools already in existence he regarded as the greatest field for agricultural education extension at the present time. The extension instructor in these schools should also give regular instruction to the adult farmers in the neighborhood and conduct demonstration plats. A plea was made for the establishment in the agricultural colleges of courses especially planned to meet the needs of extension workers.

The necessity for extension workers to be true teachers and not entertainers was also emphasized by P. G. Holden. They should be consecrated to their work and they must know their people. The plan of cooperating with the public-school system in agricultural extension work in Iowa was discussed in detail.

C. H. Tuck, in discussing the relation of extension work to rural schools in New York, recognized extension work as a part of the system of public education, and the rural-school problem as the greatest of the many that present themselves in the extension field, opening up the way for cooperating with all agencies, educators, societies, and State organizations, and the people as a whole.

D. J. Crosby, of this office, pointed out the necessity for extension workers to encourage other agencies to pursue similar lines of work as local centers, and he illustrated the point by citing a concrete case in connection with the agricultural school of Baltimore County, Md.

WORK OF THE NATIONAL EDUCATION ASSOCIATION.

SAN FRANCISCO MEETING.

At the San Francisco meeting of the National Education Association, July 8-14, 1911, considerable attention was given to agricultural education, home economics, nature study, and school gardens.

On Tuesday forenoon the department of rural and agricultural education met in joint session with the American Nature-Study Society and the School Garden Association of America, and the following topics were discussed: "Agricultural nature study," paper by J. B. Lillard, principal of the Gardena Agricultural High School, Los Angeles, and discussion by E. D. Ressler, professor of industrial pedagogy at the Oregon Agricultural College; "School gardening in Hawaii," by Vaughan MacCaughey, College of Hawaii; and the "Potentiality of the school garden," by C. A. Stebbins, department of agri-

cultural education of the University of California. Prof. Stebbins took the position that "the first aim of the school garden is to build citizenship and at the same time to create a sympathy for farming life, for it is the farm which gives solidity and character to the State." An incomplete committee report on a course of study in agriculture was submitted by the chairman, E. C. Bishop, Iowa State Agricultural College. Upon motion, the committee was given another year in which to complete the report.

The meeting of the department on Thursday morning was in joint session with the department of normal schools and the department of physical education. At this meeting "Agriculture and home economics in high schools with special reference to community work" was discussed by E. T. Fairchild, State superintendent of public instruction in Kansas; "Agriculture and home economics in normal schools with special reference to preparing teachers for community work," by President J. R. Kirk, of the Kirksville, Mo., State Normal School, Prof. R. O. Johnson, State Normal School, Chico, Cal., and Susan B. Sipe, Normal School No. 1, Washington, D. C.; "Physical education in elementary rural schools," by L. R. Alderman, State superintendent of public instruction in Oregon, and E. L. Holton, professor of rural education of the Kansas Agricultural College.

The department of normal schools also discussed at its meeting on Wednesday, the "Preparation of normal school students for industrial, agricultural, and vocational work," the paper on this subject being presented by Z. X. Snyder, president of the Colorado State Teachers' College.

The formal organization of the School Garden Association of America occurred on the afternoon of July 12, at which time a constitution was adopted and the following officers elected: President, V. E. Kilpatrick, New York; secretary, D. J. Crosby, Washington, D. C.; treasurer, Ellen Eddy Shaw, New York; vice presidents, C. A. Stebbins, Berkeley, Cal.; Louise Klein Miller, Cleveland, Ohio; Stella Nathan, Philadelphia, Pa.; Susan B. Sipe, Washington, D. C.; S. B. McCready, Guelph, Ontario; W. A. Baldwin, Hyannis, Mass.

At this session of the association Miss Louise Klein Miller gave an illustrated lecture on the "Civic aspect of school gardens"; E. C. Bishop presented a paper on the "Child's home garden in its relation to the school garden"; and R. O. Johnson read a paper on the "School garden as a center for nature study." On Friday afternoon Miss Miller spoke again on the "Civic aspect of school gardens"; B. J. Horchem, Dubuque, Iowa, gave an illustrated lecture on "School gardening, a fundamental element in education"; and Miss Sipe, an illustrated lecture on "School gardens in Washington." There was also a paper by C. A. Stebbins on "Growing children in California school gardens."

An enjoyable feature of the school garden meetings was a luncheon served in Hearst Hall to about 200 guests by the California Junior Gardeners.

Meetings of the education section of the American Home Economics Association were held on Tuesday to listen to a paper on the "Home economics movement," by Miss Isabel Bevier, of Illinois, and several addresses in memory of Mrs. Ellen H. Richards; on Wednesday to hear a paper on the "College curriculum in home economics," by Dr. A. C. True, a paper on "A 4-inch lesson in health and economy," by Miss S. Maria Elliott, of Simmons College, Boston, and a round table discussion of the "Teaching of home economics"; and on Thursday to hear papers on "Nuts and fruits as food," by Prof. M. E. Jaffa, and on the "Application of science to the housekeeper's daily problems," by Miss Ellen A. Huntington, of the Utah Agricultural College.

Dr. True called attention to the fact that college courses for women have followed too closely the lines laid down in those for men and do not give sufficient consideration to "The rôle of woman in the home and society, or as a dispenser of hospitality and a leader in the refined pleasures of life." It was his opinion that "college courses in home economics should be planned with reference to the conditions prevailing in the preparatory schools," so that where the preparatory schools do not teach home economics the students may begin this subject in the college. Continuing, he said:

Courses in home economics should be offered for college women who desire to pursue them as a part of a course of general education and to fit themselves to manage homes and meet the general requirements of social life. These courses should be planned with reference to the actual conditions of home and social life and include both practice and theory. Such courses should be allowed to form a part of a general bachelor-degree course—that is, without requiring the student to graduate in home economics.

Besides these more elementary and general courses of home economics, the colleges should offer special courses suited to the needs of those students whose major interest is in home economics and who are looking forward to professional careers in this line, as teachers, experts, nurses, dietitians in sanatoriums or public institutions, managers of hotels or of boarding departments of schools, public institutions, etc. The number and variety of such courses will depend on the funds at the disposal of the college for the home economics department, the number of instructors, and the consequent specialization of their work. Those courses should be first established for which there is the greatest demand, and the institution with limited funds should seek to give the strongest courses it can in one or two lines rather than to spread weakly out over a large field.

To indicate how home economics may be introduced into a college course on the group plan, Dr. True outlined three courses, one laying emphasis on languages, another on sciences, and the third on home economics.¹

¹ *Jour. Home Econ.*, 3 (1911), No. 5, pp. 421-428.

The report of the committee on nomenclature of the American Home Economics Association was presented at a meeting of the department of manual training and art of the National Education Association, and was as follows:

First. In the judgment of the committee the term "home economics" should be used to designate the subject as a whole wherever it is taught, and should be qualified only by the terms "elementary," "secondary," and "higher" as commonly applied to courses of instruction in different grades.

Second. Home economics is a distinctive subject of instruction, and includes the economic, sanitary, and aesthetic aspects of food, clothing, and shelter as connected with their selection, preparation, and use by the family in the home or by other groups of people.

Third. Instruction in this subject should be based on the laws of the physical, biological, and sociological sciences. The presentation should be graded according to the maturity, attainment, and purposes of the students.

Fourth. (a) Elementary schools.—In the elementary schools the central thought should be the acquiring of skill.

(b) Secondary schools.—In the secondary schools, while the work should lead to greater skill, it should also develop "the reason why" and cultivate the scientific method of thought by means of experiment. To this end it should be correlated carefully with the work in other subjects so as to economize the time of teachers and students.

(c) Higher institutions.—In the higher institutions, while skill and applied science and art are fundamental in the instruction, there should be the broader scientific, economic, and sociologic view and wherever practicable the development of research.

MOBILE MEETING.

At the meeting of the department of superintendence of the National Education Association, in Mobile, February 23-25, 1911, the general topic under consideration was "Educational achievement and educational endeavor at the close of the first decade of the twentieth century," and from the frequent mention made of agricultural education it would appear that one of the important achievements of this decade is a realization of the importance of extending instruction in agriculture from the agricultural college downward into the secondary and elementary schools.

In the session devoted to achievement and endeavor in cooperation there was frequent mention of the progress made in teaching agriculture and in the organization of boys' and girls' rural life clubs, and in the last general session, when all of the papers discussed the "Progress and true meaning of the practical in education," one of the principal addresses was by P. G. Holden, of the Iowa college,

who reviewed recent progress in teaching agriculture in elementary and secondary schools, and interpreted the meaning of the practical in teaching agriculture. C. B. Gibson, in a paper dealing with progress in vocational training, also gave much credit to recent developments in agricultural education.

In summing up the discussion for the afternoon, Carroll G. Pearse, of Milwaukee, maintained that boys and girls should be taught to live in the world to-day, and hence that vocational education has a place in the schools. Continuing, he said, "nothing is so big and important as what lies before us in the agricultural development of our country." Not only the lawyers and other professional men have the right to vocational education, but the man who works with the hoe, the ax, the awl, and the hammer, but in providing for the extension of vocational instruction downward there should be avoided the danger of neglecting essentials in intellectual instruction such as good English, mathematics, and other fundamentals of education.

The national committee on agricultural education held two meetings, at the first of which the principal paper was on "Agricultural education in the North," by J. W. Heston, president of the South Dakota State Normal School, who reviewed conditions in the North with reference to teaching agriculture in colleges, special agricultural schools, normal schools, and public schools. In the absence of J. D. Eggleston, who was announced for a paper on "Agricultural education in the South," D. J. Crosby, of this office, gave a similar review of conditions in that section.

At the second meeting of the committee, H. H. Seerley gave a review of the change in sentiment and in conditions relating to agricultural education since the committee was first organized five years ago. This change has been apparent not only in the establishment of new agricultural institutions, but in the widespread growth of sentiment in favor of teaching agriculture quite generally in the public schools.

A NEW ASSOCIATION OF AGRICULTURAL EDUCATORS.

A conference on secondary agricultural education was held in Chicago April 10. It was attended by representatives of the departments of agricultural education of Minnesota, Wisconsin, Illinois, Indiana, Michigan, and Ohio, the principals of three agricultural schools in Minnesota, and the specialists in agricultural education of the New York State department of education, the United States Bureau of Education, and this office.

Among the topics discussed at the conference was the number of units feasible to be taught in high schools having special teachers of agriculture, in consolidated rural or graded schools, and in one-room

rural schools. As regards the number of units in the four-year high school course, it was voted as the consensus of opinion that, if a special teacher of agriculture is provided, four years of agriculture are feasible and desirable. There was also considerable discussion of the scope of rural-school nature study and of ways and means of securing up-to-date information on agricultural education. A resolution was adopted requesting the cooperation of the United States Commissioner of Education and the Director of the Office of Experiment Stations in the collecting of such material.

It was voted to form a permanent organization, and K. L. Hatch, of Wisconsin, was elected president, and W. H. French, of Michigan, secretary-treasurer, with power to decide upon a name for the association and arrange for subsequent meetings. The name decided upon was The American Association for the Advancement of Agricultural Teaching.

Somewhat similar State organizations of agricultural educators have been formed in California, Illinois, Michigan, Nebraska, Ohio, Wisconsin, and probably other States.

AGRICULTURAL EDUCATION AT THE CONFERENCE FOR EDUCATION IN THE SOUTH.

The Fourteenth Conference for Education in the South was held in Jacksonville, Fla., April 19–21, with its general subject the “Redirection of education for rural communities.”

Speakers of prominence from all parts of the country and some representatives of foreign countries described successful efforts to adapt school instruction to the wants of rural communities. Dr. Paul Ritter, envoy extraordinary and minister plenipotentiary from the Republic of Switzerland, spoke on the “Adaptation of education to life in Switzerland”; Count Carl Moltke, envoy extraordinary and minister plenipotentiary from the Kingdom of Denmark, on the “Cooperative movement in Denmark and the benefits derived therefrom by the United States”; Dr. H. B. Frissell, on the “Movement for agricultural cooperation in Ireland”; Dr. J. C. Bay, on the “Folk high school and rural life of the Scandinavian countries”; and Clarence Poe, on “Some lessons from the Orient.”

Among the addresses on phases of rural-life instruction in this country were an illustrated talk on the “Reconstruction of the one-room rural school,” by Miss Jessie Fields, superintendent of schools, Page County, Iowa, and an address on “Some results of the application of newer ideals in education,” by O. H. Benson, of this department, who described boys’ corn-club work, public-school agricultural exhibits, and other features of rural-school improvement in Wright County, Iowa. Dr. J. L. Coulter, of the University of Minnesota, described typical instances of rural cooperation in America. D. C.

Ellis, of the Forest Service, gave an illustrated lecture on the "Relation of our forests to wealth and life," and called particular attention to the need of instruction concerning these matters in the public schools.

At a meeting of southern State superintendents, Supt. Joe Cook, of Columbus, Miss., read a "Review of progress in southern education," calling attention briefly to features of progress in each of the Southern States. Among the more important items relating to country-life education were mentioned legislation permitting consolidation by transportation in Arkansas; the organization of a conference on education in Florida to consider departments of manual training, agriculture, business, and home economics in public high schools; the increase in the annual income of Georgia agricultural schools to \$10,000 for each school; the maintenance of 5 summer schools for white teachers and 2 for colored teachers, and the establishment of 17 departments of agriculture in county high schools in Louisiana, each school receiving an equal share of \$25,000 from the State; the establishment of a State normal school and of 23 State-aided county agricultural schools in Mississippi; legislation in North Carolina for the establishment of State-aided farm-life schools, an increase in taxation for elementary public schools, and an increase in the appropriation for rural high schools; the stimulation of agricultural education in South Carolina by the organization of boys' corn clubs, and of home-economics instruction by the organization of tomato clubs among the girls; the organization in Texas of State-aided departments of agriculture, home economics, and manual training in 10 public high schools, and of similar departments for teachers in four State normal schools and the State university, and the addition of \$10,000 to the total appropriations for departments of agriculture and home economics in Virginia high schools. State rural-school supervisors are now employed in nearly all of the Southern States.

At an afternoon conference on "Education for larger productiveness on the farm," with President A. M. Soule presiding, President J. C. Hardy discussed the functions of the agricultural college; H. A. Morgan, of Tennessee, spoke on the training of teachers of agriculture and the development of short courses to take the place of farmers' institutes, and J. F. Duggar emphasized the importance of cooperation among all the southern educational agencies. The work of the consolidated Farragut School, at Concord, Tenn., in teaching agriculture and home economics, conducting demonstration plats, and affording social entertainment for the people of the community was described by its principal, Adam Phillips.

There was also a conference on "Education for better living in the country home," which was led by Mrs. W. N. Hutt, of North Carolina. Among other topics of importance that were discussed either at con-

ferences or at meetings of affiliated societies, were the rural school and sanitation, the church and country life, the high school and its relation to life, the school and civic improvement, and the education of the negro.

AGRICULTURAL EDUCATION AT OTHER CONVENTIONS.

At the thirtieth annual session of the Farmers' National Congress, held at Lincoln, Nebr., October 6-11, there were addresses on "Domestic science," by Miss Gertrude Rowan, of the University of Nebraska; "The relation of conservation to rural life," by Prof. George E. Condra, president of the State Conservation Commissioners of the United States; "Extension work and cooperation of agricultural colleges," by Dean Woods, of the University of Minnesota. President Edwin E. Sparks, of the Pennsylvania State College, in an address entitled "Carrying the message to the people," argued for the teaching of agriculture in the public schools and for making the public schools in the country very intensively agricultural. Prof. C. W. Boucher, of Marion Normal College, Indiana, speaking on the "Education of the farmers' boys and girls," brought out the desirability of a broader education for the farmers' sons and daughters, with a view to widening their horizon and giving them a more comprehensive view of life and its responsibilities.

The Fifth National Dairy Show, held at the Coliseum Building, Chicago, Ill., October 20-29, 1910, provided a common meeting ground for teachers and investigators, practical farmers, milk producers, users of milk, and manufacturers of dairy products. The intercollegiate student contest for judging dairy cattle was participated in by teams from the Kentucky, Missouri, Nebraska, Cornell, and Ohio State universities, and from the Iowa and New Hampshire colleges. The highest total score for all breeds was made by the Cornell team, with Missouri second, and Nebraska third. An innovation this year was the offering by the Jersey and Holstein breeders' associations of \$400 scholarships to the students making the highest scores for their respective breeds, Ivan McKillip, of the University of Nebraska, winning that for Jerseys, and T. B. McNath, of the University of Missouri, that for Holsteins.

The fifth annual conference of the Official Dairy Instructors' Association was held in connection with the National Dairy show. The principal papers read were on "Future work of the association," by C. H. Eckles, of Missouri, president of the association; "What can the agricultural college do to assist the farmers in planning sanitary barns and buildings," by O. Erf, of Ohio; "Organization of breeding centers," by A. C. Anderson, of Michigan; and "Training men for college and experiment station work," by W. A. Stocking, jr., of Cornell University. In these papers and in the reports of various

committees the need was emphasized for better trained teachers and investigators in dairying, and for efficient extension workers among the dairy farmers.

A rural life conference was held at Morristown, N. J., November 19. The speakers included President K. L. Butterfield, of the Massachusetts Agricultural College, who spoke on the rural church in country life; Assistant Secretary W. M. Hays, of this department, who discussed the rural school systems and agricultural high schools; Miss Sarah B. Askew, of the New Jersey State Library, who spoke of the benefits of traveling libraries to country people; Mrs. Frank Ambler Pattison, president of the New Jersey State Federation of Women's Clubs, as to the possibilities of such clubs in rural districts; and Preston G. Orwig, organizing secretary of the Boy Scouts of America, and Dr. George E. Fisher, of the international committee of the Y. M. C. A., regarding certain phases of their work for country boys. During the conference a commission was appointed to study rural conditions in Morris and Essex Counties, with a view to putting into practical working the suggestions presented.

At the Twelfth Annual Convention of Southern States Association of Commissioners of Agriculture, held at Atlanta, Ga., November 21 and 22, a change in name to that of Southern Agricultural Workers was decided upon, with the view of broadening the scope of the organization and including in its membership representatives from agricultural colleges, experiment stations, farmers' institutes, and others actively engaged in agricultural work.

The Eleventh International Live Stock Exposition, held at Chicago, November 26 to December 3, continued the successes of former years. The agricultural colleges and experiment stations also fully maintained their position of leadership, figuring largely in the prize winnings, and in the lists of judges. Their entries were as usual very strong in the fat-stock classes. The Iowa college won the much-coveted grand championship for single steers with Shamrock II, an Angus calf weighing 1,100 pounds at 10 months of age, and the Kansas college first place for 2-year-olds. The intercollegiate student-judging competition was keenly contested by teams from nine institutions, first place going to the University of Missouri. The annual meeting of the American Federation of Agricultural Students was held during the exposition.

At the convention of the Southern Educational Association in Chattanooga, December 27-29, considerable attention was given at both general and special sessions to the different phases of agricultural education. Representing this department, Assistant Secretary W. M. Hays gave an illustrated address on "Vocational education;" Dr. A. C. True read a paper on "Correlating the work in agricultural education;" Dr. S. A. Knapp gave an address on "Our losses; or what

we might have had;" and D. J. Crosby gave an illustrated talk on "Community work in rural high schools."

Dean Russell, of the University of Wisconsin, spoke at one of the evening sessions and showed lantern views to illustrate the "Value of demonstration methods in the agricultural education of the rural population;" J. F. Duggar read papers on "Preparing teachers to give instruction in agriculture and courses in agriculture adapted to high schools;" and P. H. Rolfs discussed "Technical education, our greatest need." There were also several other papers and discussions of this nature in the departments of higher technical education, secondary education, superintendence, and secondary industrial education.

The third annual meeting of the American Home Economics Association was held at St. Louis, December 27-30, 1910, in conjunction with the American Sociological Society, American Economic Association, American Political Science Association, American Association for Labor Legislation, and American Statistical Association. Its program in consequence gave special emphasis to the economic and sociological phases related to home economics, but there was also a long list of scientific papers, particularly in the field of dietetics and nutrition, where 15 papers were offered. There was also a session devoted to courses of instruction in home economics and on extension work as carried on by colleges of agriculture.

The National Corn Exposition, held at Columbus, Ohio, January 30 to February 11, was distinctly a national event. Selected exhibits of corn from State corn shows were in competition from 35 States, and there were also extensive educational exhibits from this department and 25 experiment stations, and of agricultural machinery, cereal food products, and dairy equipment. Daily programs of lectures, demonstrations, and conferences, addresses by speakers of national reputation, were held and special days were set apart, such as livestock day, a national dairy day, a conservation day, and a four-day rural life conference. The American Breeders' Association held its annual meeting during the exposition.

The Illinois Country Life Federation was formed at Bloomington, Ill., February 1. The organization included representatives of the agricultural college, granges, farmers' institutes, Y. M. C. A.'s, Y. W. C. A.'s, Sunday schools and churches, banded together to promote the welfare of the country. The following declaration of principles was adopted: (1) Local country community building; (2) the federation of all the rural forces of the State of Illinois in one big united effort for the betterment of country life; (3) the development of institutional program of action for all rural social agencies, which means a program of work for the school, another for the church, another for the farmers' institute, etc.; (4) the stimulation of farmer

leadership in the country community; (5) the increase and improvement of professional leadership among country teachers, ministers, and all others who serve the rural community in offices of educational direction; (6) the perpetuation among all the people of country communities of a definite community ideal, and the concentrated effort of the whole community in concrete tasks looking toward the realization of this ideal; (7) the recognition of the country school as the immediate initiator of progress in the average rural community of Illinois; (8) the study and investigation of country life facts and conditions; (9) the holding of annual country life conferences; and (10) the protection of this federation and of all country life from any form of exploitation.

THE GRADUATE SCHOOL OF AGRICULTURE.

The enrollment at the fourth session of the Graduate School of Agriculture, held at the Iowa State college, Ames, Iowa, July 4-29, 1910, was larger than at any previous session, and the interest manifested by the students was never surpassed.

The general plan of organization was the same as before. The Association of American Agricultural Colleges and Experiment Stations, through its standing committee on graduate study, was in general charge of the school. Many of the colleges represented in the association contributed to its support. The Iowa State college, through its president and trustees, generously became responsible for its maintenance. The division of agriculture of this institution, through Dean Curtiss and other members of the faculty, made the local arrangements for the session and otherwise contributed in many ways to its success. The lectures and seminars were for the most part held in the spacious and well-equipped Agricultural Hall; and other buildings, libraries, live stock, and other equipment of the college were placed at the disposal of the school. Dr. A. C. True, Director of the Office of Experiment Stations, served as dean, as at the previous sessions, and Prof. W. H. Pew, of the Iowa State college, acted as registrar.

The total enrollment of students at the close of the session was 205, 3 of whom were women, and 3 were members of the Negro race. Twelve other women were registered in the Graduate School of Home Economics, which was held at the college July 6-20, and was conducted in close affiliation with the Graduate School of Agriculture. In 1908 the number of students was 144 men and 19 women. In 1910 the students came from 39 States and the District of Columbia, in addition to 3 students from Canada and 1 each from Scotland, Cuba, Denmark, Russia, and the Transvaal.

The public opening exercises of the school were held on the evening of July 6 in the college auditorium and were attended by 700 persons

from the college community, the town of Ames, and other parts of Iowa, as well as by the members of the graduate school. An address of welcome was made by Dean C. F. Curtiss on behalf of the Iowa State college. President W. O. Thompson, of Ohio State University, chairman of the executive committee of the Association of American Agricultural Colleges and Experiment Stations, responded on behalf of the association, giving an interesting account of the inception of the school and urging the importance of maintaining it on a high plane.

Dr. H. P. Armsby, of Pennsylvania State college, chairman of the committee on graduate study, discussed the need and importance of systematic graduate study as a part of the preparation of teachers and investigators in agriculture, and pointed out that the true mission of this national graduate school of agriculture was to stimulate our college and station workers to seek a broader and deeper training and to lead the way for the establishment of regular graduate courses in agriculture in our best agricultural colleges. He also urged that these colleges should lay great stress on the preparation of teachers and investigators, since they must be the chief source from which these workers on behalf of agricultural progress would come.

Dean True, of the graduate school, gave a brief history of the enterprise, and stated that among the more specific aims of the school are the following:

- (1) To stimulate more thorough study in the several branches of agricultural science.
- (2) To promote more systematic attention to problems of agricultural education.
- (3) To emphasize the vital importance to agricultural progress of the honest and rigid ascertainment of facts and the discovery of underlying principles.
- (4) To aid the establishment on a sound basis of the profession of agricultural science and teaching and the formulation of a satisfactory code of ethics for this profession.
- (5) To bring students and teachers of agricultural science in the several States and in different countries into closer touch and sympathy.
- (6) To bring workers in the so-called fields of pure and applied science into closer and more helpful relations.
- (7) To promote the more efficient and economical use of public and private funds devoted to agricultural education and research, by holding up the fundamental importance of thorough training and the right spirit in the teacher and investigator and denouncing the substitution of political and personal motives in the management and work of our agricultural institutions, for the love of truth and devotion to public interests.

He also pointed out the great expansion of agricultural education and research in this country and the consequent increase in the openings for well-trained men in our agricultural institutions.

But most significant is the broadening of the field of activity of agricultural experts and the realization by our agricultural leaders and institutions that a truly progressive and permanently prosperous agriculture can only be reached through the quickening of the social and moral impulses of country people, as well as their intellectual faculties, and through the general improvement of the conditions of country life.

The new development does not in any degree minimize the importance of the work of the agricultural specialist who is delving into the problems of agricultural production. On the other hand, it should stimulate him to higher and more thorough endeavor in his investigating and teaching when he realizes how the results of his work may affect the happiness and success of multitudes of men and women who live in the open country and deal in practical ways with the problems which it is the business of the agricultural scientist to solve. The growing interest in the human problems of agriculture should put new life into the effort to solve its scientific problems.

The courses of study offered by the school covered eight main lines: Plant physiology and pathology, agronomy, horticulture, animal husbandry, poultry, dairying, rural engineering, and rural economics. The courses in the last two subjects were given for the first time. The hours were so arranged that all interested in plants could attend the course in plant physiology, and a similar arrangement was made for the course in animal husbandry. Seminars, as well as lectures, were provided, and the program made it possible for the student to follow several lines of work, special attention being given to methods of investigating and teaching.

The faculty numbered 57, in addition to 17 speakers at special conferences. It included 12 officers of the United States Department of Agriculture, 16 members of the faculty of the Iowa State college, and 33 professors and experts from 17 other agricultural colleges and experiment stations. In addition, lecture courses and seminars were offered by Dr. D. T. Macdougal, of the Carnegie Institution, of Washington; Prof. J. S. Pray, professor of landscape architecture of Harvard University; Dr. W. E. Castle, professor of zoology of Harvard University; and Dr. C. W. Gay, professor of animal husbandry of the University of Pennsylvania. The international relations of the school were brought out by the very interesting and valuable lectures given by Dr. E. von Tschermak, professor of plant breeding in the Royal Imperial College of Agriculture of Vienna, Austria; Dr. J. C. Ewart, professor of natural history of the University of Edinburgh, Scotland; and Prof. G. E. Day, professor of animal husbandry of the Ontario Agricultural College, Guelph, Ontario.

The more general interest of the session naturally centered in the courses in plant physiology and pathology and animal husbandry. In the former, principles of plant breeding were discussed by Dr. Webber, of Cornell University; Dr. von Tschermak; Dr. Macdougal; and Dr. Stone, of the Massachusetts Agricultural College, with special reference to their own investigations in various branches of this subject. Dean Bessey, of the University of Nebraska, treated of plant eggs and sperms, embryology, and the relations of the sun and water to the growth of plants. Different problems in plant pathology were presented by Mr. Haven Metcalf, of the Bureau of Plant Industry; Dr. Stevens, of the North Carolina Agricultural College; and Dr. Pammel, of the Iowa State college. Considerable attention was given to methods of investigation and teaching.

In the course in animal husbandry Dr. Castle gave most instructive and inspiring lectures on the principles of heredity applicable to animal breeding, which were illustrated by his own researches with rodents. Dr. Ewart treated in a very clear and forceful manner a number of breeding problems to the solution of which his own investigations have notably contributed, such as transmission of acquired characters, telegony, saturation, maternal impressions, influence of environment, intercrossing, inbreeding, and prepotency. President Waters, of the Kansas State Agricultural College, discussed the factors affecting type, form, and quality of carcass, with special reference to investigations conducted under his supervision at the Missouri Experiment Station. Prof. Eckles, of the University of Missouri, summarized the results of his investigations in feeding and breeding dairy cows. Dr. Armsby, of the Pennsylvania State college, gave an account of his recent investigations with the respiration calorimeter on the maintenance requirements of farm animals, in continuation of work presented at former sessions of the school. Mr. E. W. Morse, of this office, gave two lectures embodying special studies he has made on the history of cattle. Types and breeds of different classes of animals were treated by several lecturers with numerous lantern-slide illustrations.

A large variety of living animals, mainly belonging to the Iowa State college, were also exhibited and discussed in the seminars given in connection with this course. In this way beef cattle were discussed by Dean Curtiss and Prof. Dinsmore, of the Iowa college; horses by Prof. Kennedy, of the Iowa college, and Dr. Gay, of the University of Pennsylvania; sheep by Dean Skinner, of Purdue University, and Prof. Wentworth, of the Iowa college, and swine by Prof. Day, of the Ontario Agricultural College. In these and other courses given at this session of the school there was an unusually thorough treatment of scientific and practical matters. Much of the work was of the best type of university grade, and in general it was truly appropriate to a graduate school.

A course in rural engineering was given for the first time in the history of the school. Courses of lectures on irrigation were given by Dr. Fortier, of this office; on drainage by Mr. Elliott, of this office; on water supply, drainage, and ventilation of farm buildings by Prof. King, formerly of the University of Wisconsin; on power and machinery for farms by Prof. Davidson, of the Iowa college, and on the Iowa silo by Mr. King, of the Iowa college. Methods of teaching agricultural engineering were also discussed.

One of the most important enterprises of this session of the graduate school was the course in rural economics and sociology. Owing to the broadening of public interest in the more general problems of country life and the more active efforts of the agricultural colleges to

establish adequate courses of instruction in farm management and rural economics and sociology and to institute definite investigations along these lines, it was thought best to undertake at this session of the school a general discussion of the field of teaching and investigation in these lines. The result proved the wisdom of establishing such a course. It was largely attended and great interest was evoked by the lecturers.

Dr. Taylor, of the University of Wisconsin, opened the course with a discussion of the scope of agricultural economics and the methods used in studying this subject. Afterwards he presented the economic status of the American farmer and the issue between the farmer and the middleman.

Dr. Hibbard, of the Iowa college, followed with a quite definite treatment of agricultural cooperation and illustrated various phases of the present cooperative movement by reference to the Grange and to cooperative credit companies, grain elevators, and associations of fruit growers and cotton and meat producers. President Butterfield, of the Massachusetts Agricultural College, outlined the field of rural sociology, showed the place of this subject in college courses and how such courses may be developed, and urged the importance of country-life investigations and a campaign for rural progress. Prof. Spillman, of the Bureau of Plant Industry, told of the development of investigations in farm management in this department and in the colleges and stations, and pointed out the scope of farm management as a subject of investigation and instruction.

The rapid progress being made in the outlining of the scope of the general subjects included in this course was definitely brought out through the lectures and discussions. Since the hearers at this course represented institutions in many States it is believed such a presentation of these subjects at the graduate school will do much to aid the more definite establishment of work in these lines in colleges in various parts of the country. This belief is strengthened by the fact that those interested in farm-management investigations and teaching formed an association to be known as the American Farm Management Association, with W. J. Spillman, president; D. H. Otis, vice president, and G. F. Warren, secretary-treasurer.

Another new and highly successful feature of this session was a series of conferences on extension work. This work is rapidly developing in our agricultural colleges, but there is as yet little consensus of opinion regarding its field of operation and methods of organization and procedure. It was therefore thought best to have a broad survey of the field from different points of view. By such a presentation of the present status of the movement, together with some discussion of many unsettled problems, it was hoped to pave the way

for a more definite and rational consideration of the subject in the agricultural colleges generally.

The discussion was opened by the presentation of the scope and organization of university extension work in general by Dr. Reber, director of the extension work of the University of Wisconsin. President Sparks, of the Pennsylvania State college, formerly in charge of extension work in the University of Chicago, continued the discussion of this theme and in particular brought out and answered some of the objections to extension work as undertaken by the universities. At the second conference Prof. Hamilton, of this office, outlined the present status of extension work in agriculture in the United States and European countries as regards financial support, organization, and methods and kind of work.

The sphere of agricultural extension work was the theme of the third conference. The discussion under this head was led by President Soule, of the Georgia State College of Agriculture, and Dean Price, of the college of agriculture of Ohio State University. It was thus made apparent that the extension work of the agricultural colleges falls under two general heads: (1) The giving of information to adult farmers and their families which can be immediately applied to practice on their farms and in their homes, and (2) a campaign for the improvement of rural schools, including information and training of teachers in elementary and secondary schools along agricultural lines.

The fourth conference was devoted to some of the problems of agricultural extension work, as presented by President Butterfield and Prof. Miller, superintendent of extension work in the Kansas college. Finally, attention was given at the fifth conference to (1) organization, by Dean Burnett, of the college of agriculture of the University of Nebraska; (2) equipment and methods, by Prof. Christie, superintendent of agricultural extension work at Purdue University; and (3) the qualifications of extension teachers, by Dean Hunt, of the Pennsylvania State college.

Meanwhile, under the direction of Prof. Holden, superintendent of agricultural extension work of the Iowa State College, several meetings of extension workers and others had taken place in which the methods of equipment used by that college were quite fully displayed and discussed. The large amounts of apparatus, charts, and illustrative material assembled by the Iowa college for this work was a revelation to many. Afterwards a round table of extension workers helped to bring together some of the valuable results of the conferences. A meeting of extension directors and workers was also held for the discussion of administrative questions.

This was by far the largest and most important assemblage of persons directly connected with the extension work of our agricultural

colleges. The vital relation of the proper development of this branch of agricultural education to the general success of the colleges was clearly brought out. There was also a much more definite realization of the tremendous extent and importance of the extension movement in its relations to the permanent success of American agriculture and the welfare of our rural people.

Secondary education in agriculture occupied a new and important place in this session of the graduate school. There was a relatively large attendance of men engaged in agricultural instruction in the special agricultural schools, public high schools, and normal schools in different parts of the country. One formal conference on secondary agricultural education was held, at which Prof. Warren, of Cornell University, discussed where and how to teach agriculture, Mr. D. J. Crosby, of this office, gave a review of the present status of agriculture in secondary schools, and Prof. Davis, of Miami University, Ohio, discussed the training of teachers of agriculture. A number of more informal conferences were also held, at which the work in secondary education in agriculture in different States was described, and questions relating to organization, courses of study, equipment, and methods of teaching were earnestly discussed.

Interesting conferences were held on agricultural journalism and the relation of agricultural education to the business of farming. At the former the qualifications necessary for success in agricultural journalism were discussed by Mr. Henry Wallace, and college courses in this subject were described by Prof. Marquis, of the University of Wisconsin, and Prof. Gregory, of Iowa State College. At the latter Dr. William Hill, of the University of Chicago, called attention to the difficulties encountered by the agricultural colleges in devising systems of farm accounting and in training farm managers, and described two enterprises inaugurated under his direction to overcome some of these difficulties. Dr. Ewart spoke very briefly of the work of schools and boards of agriculture in Scotland and Ireland, and Mr. Crosby gave an illustrated address on the practical features of high-school instruction in agriculture.

A general excursion was given to Odebolt, Iowa, where the party was met by farmers and other citizens with about 30 automobiles, and thus were enabled to visit a number of large estates within a range of 40 miles, where different forms of management of large cropping areas were illustrated. A general view of Iowa agriculture was also obtained en route under most favorable conditions, and the generous hospitality of the people of this region was amply demonstrated. The members of the school interested in agronomy also visited a fine farm largely devoted to the growing of seed grains near Marshalltown, Iowa. Smaller parties of botanists and others made excursions to various points in the vicinity of Ames. The Inter-

national Association of Poultry Instructors and Investigators held a meeting beginning July 30.

The steady rise of interest in the graduate school since its first session and the growing attendance are sure indications that it is filling a useful place in our scheme of agricultural education. The attendance and interest might be considerably increased if all our agricultural colleges and secondary schools would regularly arrange for the attendance of at least a portion of their faculties at each session. It is believed that none of these institutions can afford to neglect to make such provision.

THE AGRICULTURAL COLLEGES.

Agricultural colleges were in operation during the year in all the States and Territories except Alaska. Counting the 16 separate institutions for negroes in the South, there were 67 such institutions. The attendance at these institutions and the funds available for their support were greater than in any previous year. They had 53,708 students in interior courses, 169,121 in exterior courses, including correspondence and extension courses (not farmers' institutes), and 35,191 in all other courses, making a total, counting none twice, of 258,020 students. This was an increase over 1910 of 90 per cent. Included in this increase, however, were 26,667 matriculates in "farmers' week" courses at the colleges, which were formerly classed as farmers' institutes. But if these were omitted from present consideration there would still be an increase of 71 per cent in the number of students reached directly by the land-grant colleges.

The agricultural students in these institutions increased from 17,375 in 1910 to 19,170 in 1911, a 10 per cent gain. The additions to the equipment of these colleges were valued at over five and one-half millions, and to their income over eight hundred thousand.

APPROPRIATIONS.

The State appropriations for the support of the agricultural colleges include some of the most liberal provisions ever made for the maintenance and improvement of educational institutions.

The University of Illinois was given \$3,600,000, of which \$952,300 was for the agricultural college and experiment station. Among the several items granted are \$19,000 for the purchase of improved live stock and \$153,000 for new buildings. This includes \$80,000 for a live-stock building and large pavilion to cost eventually \$100,000, and \$20,000 for the purchase of 40 acres of land for the poultry plant and additional field experiments.

The Kansas college and station has an appropriation of \$985,000 for the ensuing biennium. The law relating to the inspection of feeding stuffs was revised and the fees made larger, thereby increasing the revenues of the college.

In Minnesota the legislature granted \$1,283,900 to the university, \$399,700 for the school of agriculture at University farm, \$89,200 for the Crookston School of Agriculture, and \$199,750 for the Morris Agricultural School.

Substantial increases in the appropriations were made to the Montana Agricultural College and Experiment Station, the aggregate provided for the ensuing biennium being \$274,295. Of this, \$102,295 was for maintenance of the college, \$36,000 for demonstration work and dry farming, and \$10,000 for greenhouses.

In North Carolina the legislature gave the Agricultural and Mechanical College, at Raleigh, \$30,000 for an animal husbandry building. There was also provided \$80,000 annually for maintenance.

In Oregon the total State appropriation for the college and station during the biennium aggregated \$681,500. Of this, \$273,500 was for new buildings and improvements, among the items being \$36,600 for a horticultural wing of the agricultural building, \$29,700 for a dairy building, \$14,600 for a farm mechanics building, and \$7,600 for a stock judging pavilion. The appropriation for maintenance of the college was nearly doubled, being made \$150,000 per annum.

Under a recently enacted law 28 per cent of the income derived from a tax of $4\frac{1}{2}$ mills is to be available for the maintenance of higher education in Utah. Of this amount 28.34 per cent is to be allotted to the agricultural college, 64.43 per cent to the State university, and 7.23 per cent to the State normal school.

The Washington Legislature appropriated \$485,000 for maintenance of the agricultural college and station. A law was also passed providing a tax of 0.325 mills on the assessed valuation of the State for the support of the college and station for the years 1913 to 1918, inclusive. It is estimated that this tax will provide a revenue of \$320,000 per year at the beginning of the period.

BUILDINGS.

A new agricultural building is in process of construction at the University of California. This is a white granite structure, 162 by 64 feet. The main floor will contain a lecture room to accommodate approximately 500, a museum, the agricultural library, offices, and a laboratory for horticulture and viticulture. On the second floor will be laboratories for entomology and plant pathology, and additional offices and lecture rooms. A laboratory for experimental work in plant pathology, the mailing rooms, a lecture room, and other offices will be housed in the basement.

The new dairy barn at the Delaware Agricultural College is now completed. This barn, which was made possible through an appropriation by the legislature, has accommodations for 75 head of cattle and has many modern features of construction.

A large building convenient to the campus of the University of Idaho has been leased for the use of the new department of farm machinery. This building is being equipped with about \$15,000 worth of farm machinery, including traction engines, motors, farm automobiles, and similar appliances. Work in farm architecture will also form a part of the course. This is stated to be the first farm engineering course to be offered in the Northwest.

The new dairy building at the New Hampshire Agricultural College has been completed. It is a terra cotta, tile, and cement fireproof structure, with a main portion two stories in height with about 55 feet frontage and 48 feet in depth, flanked by two 1-story wings 37 by 11½ feet. On the ground floor is a large demonstration room for dairy machinery and a laboratory equipped for dairy chemistry work, with the college creamery in the rear. The second story is occupied by offices, classrooms, and a reading room.

A woman's building has been erected at the Oklahoma Agricultural College at a cost of \$62,000. (Pl. X.) It has in addition to the living rooms a large gymnasium, with plunge and shower baths adjoining, classrooms for home economics work, a commodious reception hall, a modern kitchen, and a dining hall that will seat 160 students. The new boys' dormitory, costing about \$28,000, contains living rooms for 100 boys, and is modern in every respect. Both buildings are provided with hospital rooms.

The new poultry hospital for use in connection with the study of poultry diseases at the Rhode Island Agricultural College is now completed. This hospital, with its modern equipment, is believed to be the first of its kind to be erected for this special purpose in this country and probably in the world.

The new dairy barn at the South Dakota Agricultural College has been completed at a cost of about \$10,000. It is planned to use a portion of the building for classrooms and experimental laboratories.

The \$30,000 dairy laboratory at the University of Wisconsin has been completed and was used for the winter dairy course. A new sheep barn, silo, manure storage shed, potting house, and four greenhouses have also been erected, and work has been started on a horticultural building. An allotment of \$60,000 is available for the new horticultural equipment. The formal dedication of the new forest products laboratory took place June 4, 1910, Forester Graves, of this department, President C. R. Van Hise, of the Wisconsin University, Gov. J. O. Davidson, and ex-Gov. W. D. Hoard participating in the exercises. The laboratory is a three-story brick structure, trimmed with white sandstone, erected by the university at a cost of \$75,000, and equipped by this department for a like sum. (Pl. XI, fig. 1.) Courses in wood technology and the mechanical engineering of wood-manufacturing plants are to be added

to the university curriculum next year, the college of engineering cooperating with the staff of the forest products laboratory in the instruction.

WORK OF THE COLLEGES.

One of the most marked features of progress has been the increased number of students in agriculture.

The attendance of students upon classes in the Arkansas College of Agriculture increased about 13 per cent over the preceding year. The enrollment in the college of agriculture at Cornell University reached 1,254, an increase of more than 34 per cent over the preceding year. The entering class at the Massachusetts Agricultural College numbered 160, which was an increase of 25 per cent. At the Minnesota College of Agriculture the attendance increased from 285 in 1910 to 405 in 1911. The entering class in the 4-year and 2-year courses of the Wisconsin College of Agriculture showed an increase of about 60 per cent, and in the department of home economics the total increase was about 100 per cent. Six foreign countries were represented in the enrollment in the college of agriculture.

Arrangements were completed for the cooperative use by the Kentucky college of a large estate within 5 miles of Lexington as a source of illustrative material for study and investigations. It is expected that in this way it will be possible to study dairy and live-stock methods under practical conditions and to test results of plant-breeding studies and similar work.

The entrance requirements at the Michigan Agricultural College were increased to a minimum of 15 high-school units, of which from 1 to 3 may be offered in agriculture. Correspondence courses in agriculture and home economics have been established.

The New York State College of Agriculture established a department of forestry with Walter Mulford, junior professor of forestry of the University of Michigan, as its head. The pomology work was separated from the department of horticulture and organized as a distinct department in charge of C. S. Wilson as professor of pomology. Three additional fellowships were announced. One of these is for the investigation of the effect of cement dust on the setting of fruit, and another for the investigation of the nature and control of the diseases of orchard crops, especially the New York apple-tree canker. The third fellowship, for the investigation of the nature and control of the fungus diseases and insect pests of orchard crops near Batavia, carries an appropriation for two fellows, one in the department of plant pathology and the other in the department of entomology. The trustees decided to charge tuition to students in the college of agriculture who are not residents or citizens of the State.

According to recent data 46 $\frac{2}{3}$ per cent of the graduates of the North Dakota Agricultural College are now engaged in experiment station work, 16 $\frac{2}{3}$ per cent are farming, 13 $\frac{1}{2}$ per cent are teaching agriculture in agricultural colleges, 10 per cent are teaching agriculture in high schools, 10 per cent are agricultural extension lecturers and demonstrators, and 3 $\frac{1}{2}$ per cent are connected with farm journals. Of the 1,582 young men who have taken the shorter courses in agriculture during the past 5 years, 95 per cent are said to be employed in farm work.

During the past two years a course of lectures has been given on forestry at Lehigh University. In addition to this an arboretum is being developed in the university park for the education of the public as well as of the student body, and a museum of cut woods showing samples of timber is being assembled.

Instruction in agriculture is now offered by the department of education of the University of Porto Rico in 6 of the 41 supervisory districts. In each of these districts there is a special teacher of agriculture who gives instruction in the graded schools and superintends the work of the rural teachers in that subject.

A bill was passed by the Utah Legislature allowing the agricultural college to offer degree courses in agricultural engineering, this to include courses in irrigation, drainage, public roads, water supplies, and sanitation, farm buildings, and farm machinery.

A new line of work dealing with problems of city milk supply and ice cream making has been organized at the University of Wisconsin. A course in agricultural advertising is also offered. The course comprises lectures on methods of farm advertising and practice in the writing of advertisements of live stock, seeds, dairy products, etc. A new field course in farm management was tried out with eight students for a period of three weeks, both students and instructors living in tents. The first camp was pitched in a cow pasture near a small station called Bethesda Crossing, and the second in an orchard at Rosendale. In the vicinity of these camps the boys studied some of the most successful farms in Wisconsin.

Probably the greatest factor in the development of engineering education in this country was the passage of the Morrill Act in 1862, providing for colleges of agriculture and mechanic arts throughout the Union. In 1909 there were, according to the report of the Commissioner of Education, a total of 31,748 engineering students in all the universities, colleges, and technical schools of the United States. Of this total number, 17,892 were in the land-grant colleges. These and other data show that the land-grant colleges are training more than 56 per cent of all the engineering students of the Nation. The movement, however, in the direction of training men for the engineering work of the farm and the country dates back but a few years,

and as yet only one of the 67 institutions, the Iowa State college, offers a degree in agricultural engineering. Departments of agricultural engineering and of farm mechanics have now been provided in about a dozen of the agricultural colleges, and the men in charge of these departments are illustrating by their work the importance of this subject as a branch of agricultural education. As yet, however, much remains to be done in the way of adequate provision for this subject and in a broader realization of its importance.

TRAINING OF TEACHERS.

In response to a large demand for strong, broadly educated, well-trained teachers of agriculture for high schools and other institutions, public and private, the Iowa Agricultural College has established a department of agricultural education under the direction of A. V. Storm.¹ The general studies of the course, which extends over four years, include mathematics, history, English, chemistry, botany, zoology, physics, and some modern language if desired. The agricultural studies include work in farm crops, soils, dairying, live stock judging, horticulture, and agricultural engineering. The domestic science studies include the special studies of the home economics department. Elective work can be taken from subjects such as the principles of teaching, secondary education, history of education, and methods.

New courses in agricultural education have been organized in the college of education of Ohio State University and will be devoted to the training of high and elementary school teachers of agriculture. Following are the tentative courses offered: (1) Elements of general agriculture, (2) the teaching of agriculture in the high school, especially intended for superintendents, principals, and teachers of secondary agriculture, (3) teaching elementary agriculture, designed to meet the pedagogical requirements of township superintendents, rural teachers, and teachers in village elementary schools, and (4) rural life and institutions, which will constitute an inquiry into the status of social life in rural communities, and the various institutions through which this life finds expression. One of the two courses in agricultural education given during the summer session was designed to meet the needs of the elementary and rural teachers, who are, under a recent law, required to teach agriculture in their schools.

The Wisconsin Legislature has taken over the Stout Institute at Menomonie and provided for its maintenance by the State. This assures the continuance of one of the leading industrial teachers' training schools in the West.

¹ Professor Storm has since resigned to take charge of a department of agricultural education in the Minnesota College of Agriculture.

A spring school of agriculture, home economics, and related subjects for teachers was offered by the Kansas Agricultural College from March 28 to June 14.

The New York State College of Agriculture, at Cornell University, held its first summer school for teachers from July 6 to August 6, 1911. The special purpose was the training of teachers in agriculture, nature study, and home economics.

Besides the four weeks' summer course in agricultural practice for teachers at the Michigan Agricultural College, there was also a conference of ministers with lectures each forenoon, an open conference each day at 11 a. m., and afternoon lectures and demonstrations in horticulture and domestic science, the latter for ministers' wives.

The number of institutions offering summer courses for teachers has continued to increase. The primary purpose of these summer schools is to furnish teachers, ministers, housekeepers, business men and women, and all others interested directly or indirectly in better home making, better farming, and better schooling, an opportunity to study the elements of scientific agriculture, home economics, and manual training at a season of the year when they can attend and when much of this work can be studied to the best advantage, and also an opportunity to counsel together regarding ways and means of promoting these great movements.

EXTENSION AND SHORT COURSES.

A new phase of agricultural instruction has developed in recent years in the various forms of agricultural extension work. This movement is destined to be far-reaching in its results, and it is clearly one of the most potent influences in the education of the people along agricultural lines. This phase of agricultural instruction, which is bringing science to the aid of agriculture by reaching the man in the field and on the farm, the children in the public school, the family in the home, is calling for well-trained men far in excess of the supply.

In 43 States there were directors in charge of extension work. Among the States giving the largest appropriations for this work were Iowa and New York, \$50,000 each; Indiana, \$49,200; Minnesota, \$42,000; Ohio and Wisconsin, \$40,000 each; Kansas, \$35,000; Georgia, \$30,000; Massachusetts, \$20,000; Illinois, \$19,900, and Nebraska, \$17,500.

The extension work during the year has included such enterprises as educational trains, trolley cars, movable schools, boys' encampments, work with public school teachers, boys' and girls' agricultural clubs, correspondence courses, and farmers' institutes. A more detailed account of this work may be found in the report of the farmers' institute specialist, beginning on page 343.

Short courses have increased both in number and variety. A short course for boys and girls who won prizes in the various county agricultural and domestic science contests of Minnesota was held during the week of March 26 with an enrollment of 106.

A conference on agricultural education was held at the University of Minnesota in July, 1910. The object of the meeting was to formulate a plan for the future development of agricultural instruction in the State. As a means toward this end resolutions were adopted favoring the gradual extension of State aid to public high schools, graded schools, and consolidated schools for departments of agricultural instruction; appropriations for State aid to encourage the consolidation of small rural schools; increased funds for State teachers' training schools; liberal maintenance and equipment funds for institutions established for the general training of teachers; a limited number of agricultural schools like those at St. Anthony Park, Crookston, and Morris, with strong faculties and adequate equipment for advanced practical agricultural training; training in industrial arts in graded and high schools, supplemented by continuation schools; and a State appropriation to be used as premiums for a State industrial contest for boys and girls.

The rural education department of the Kansas Agricultural College helped in the organization of companies of Rural Life Boy Scouts. The plan was to form local companies wherever six or more boys between the ages of 12 and 20 years desired to become members. These companies are kept in close touch with the agricultural college council, and also with county councils, and a chairman appointed by the agricultural college. Monthly meetings are provided for, with a regular order of business, and rural life camps of instruction for each company. The program of the instruction camps includes games and athletic contests, contests in judging farm crops and stock, naming birds, wild animals, fish, flowers, trees, shrubs, etc., talks on rural life subjects, and other features.

The scouts are divided into three classes, according to their knowledge of birds, wild animals, fish, flowers, trees, and other natural objects, the amount of work they do in the way of cultivating crops and caring for live stock, and the amount of money they have on deposit in their own bank accounts. Thus scouts of the first class are supposed to know by sight and call 50 common birds of Kansas, by sight and track all wild animals of Kansas, by sight all the common game fish of Kansas, 25 wild flowers, all common trees and shrubs of Kansas, and 25 common weeds. They are to plant and cultivate not less than 2 acres of farm crops, to own and care for some pure-bred domestic animal valued at not less than \$25, to maintain a bank account of not less than \$25, and to read at least two books on rural life.

In Massachusetts short courses were unusually well attended, many being turned away on account of lack of accommodations.

A school of agriculture for boys, held at the Oklahoma State Fair during the week of October 3, 1910, was attended by 150 boys. In view of the success of the work the State board of agriculture has authorized the college officials to plan for holding six of these schools in different parts of the State during the coming year, to which both boys and girls are to be admitted.

It is quite evident from the increasing number of rural progress conferences held during the year that the rural problem has ceased to be an individual problem and is now a great sociological problem. These conferences have dealt with such rural life matters as the rural church, the grange, boys' and girls' clubs, the school as a social center, rural social betterment, and sanitation.

THE SECONDARY SCHOOLS.

During 1911 about 2,000 public and private high schools in the United States gave instruction in agriculture. The number of States giving special aid to high schools maintaining approved courses in agriculture increased from 6 to 11, and the number of schools thus aided increased from 28 to about 250. Four new State agricultural schools were opened in Arkansas and similar schools were provided for, 2 in Colorado, and 1 each in Nebraska and Vermont. County agricultural schools were provided for in North Carolina and North Dakota.

Of the 185 State normal schools, 104 offered courses in agriculture during the year, and 18 others, courses in nature study or school gardening. Several of the State normal schools conducted courses for farmers and held farmers' institutes. The tendency in all the secondary school work is to get in touch with the business and social interests of the communities.

RECENT PROGRESS BY STATES.

ALABAMA.

The annual appropriation of \$4,500 to each of the nine State agricultural high schools was increased by act of the legislature in 1911 to \$7,500, but owing to a shortage of funds in the State treasury the additional funds were not available at the beginning of the new year. By act of the same legislature a new school will be established at Lineville. Agricultural and home economics are to be taught in all grades of this school, thus making it strictly industrial.

ARKANSAS.

The four State agricultural schools were opened to students and have a total enrollment of about 670. In each case a main building

and one or two dormitories were erected, farms were purchased, and some farm animals and equipment provided. It is the plan henceforth, in accordance with the provisions of the act establishing these schools, to erect buildings and make improvements by means of student labor. (See Plates XI, fig. 2, and XII.)

CALIFORNIA.

Eleven public high schools gave instruction in agriculture with a definite vocational purpose in view. Four of these, the high schools at Gardena, Imperial, Oxnard, and Bakersfield, had given instruction in agriculture during the previous year. At Gardena, which is a suburb of Los Angeles, the name of the school was changed to Gardena Agricultural High School, and the work was organized more definitely along vocational lines (Pl. XIII, fig. 1). One other high school in the Los Angeles group, that at Hollywood, conducted a regular course in agriculture.

At Imperial a high-power automobile was used to bring the pupils of the surrounding country to the consolidated school, at a cost to the pupils of about 15 cents a day. The automobile also served as a neighborhood means of intercommunication and as an "agency of civilization."

At Bakersfield the fair grounds, containing 27 acres of land, were purchased for \$16,000, to be used as the school farm (Pl. XIII, fig. 2). This is located about three-fourths of a mile from the high-school building. The buildings on the farm include a residence for the teacher of agriculture, a commodious shed for farm implements and workroom (Pl. XIV, fig. 1), a large exhibition hall, which had not yet been utilized by the school, and some small poultry colony houses.

The high school at Oxnard had a small farm containing $2\frac{1}{2}$ acres which was used for plat work with alfalfa, individual and community gardens, a small nursery, and an experiment in eradicating morning glories by pasturing hogs on the plat. About 25 students were enrolled in agriculture. (Pl. XIV, fig. 2.)

The other schools conducting agricultural courses in 1910-11 were Fresno, Stockton, Livermore, Ferndale, Lordsburg, and Escondido, in addition to which more general courses in agriculture were offered at Sebastopol, Salinas, Le Grand, Porterville, Brawley, Ceres, and Petaluma.

COLORADO.

The laws of 1911 provided for the establishment of a school of agriculture and mechanic arts at the Fort Lewis School, formerly a United States Indian school. The school is to be in charge of the State board of agriculture, which also controls the State agricultural

college. The State appropriated for the school during the next biennium \$75,000, not less than half of which must be expended for equipment.

IDAHO.

The new school code adopted by the legislature in the 1911 session requires that elementary agriculture and home economics be taught in all rural high schools.

A school of practical agriculture was opened at the University of Idaho with a course of study to extend over three years, of six months each. The purpose of this school is to provide practical industrial and agricultural training for those young men who are unable or do not care for such courses as the ordinary high school of the State offers.

ILLINOIS.

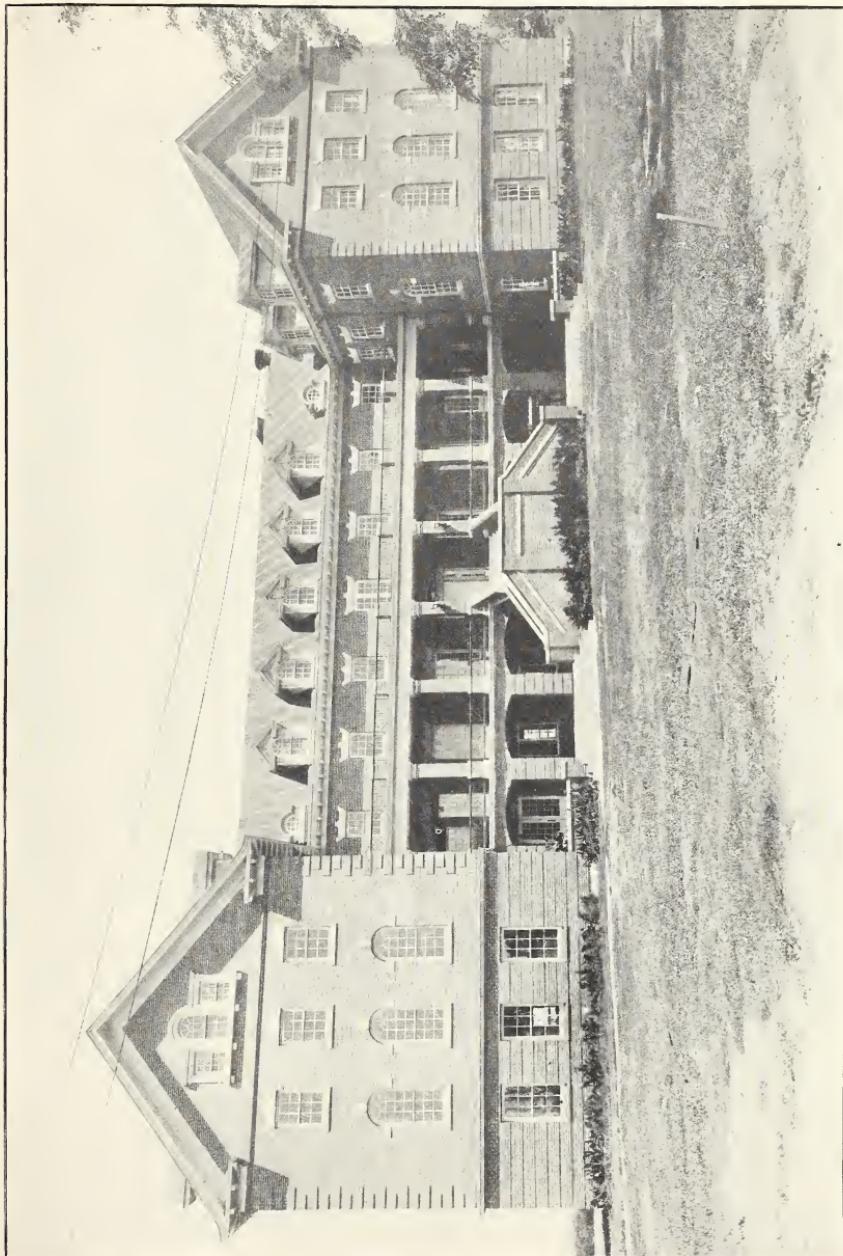
The legislature at its last session provided for a \$20,000 State fair school of home economics at Springfield.

IOWA.

In the winter of 1911 the legislature of Iowa made provision for the establishment of normal training courses for teachers in any accredited 4-year high school, and made an appropriation of \$25,000 for 1912, and \$50,000 annually thereafter, for the purpose of encouraging the establishment of these normal training courses for the training "of teachers for the rural schools by requiring a review of such given branches as may be deemed essential by the State superintendent of public instruction, and for instruction in elementary pedagogy and the art of teaching elementary agriculture and home economics." In counties having only one high school approved under the provisions of this act \$500 may be paid toward the support of the normal training course, but in counties having more than one normal training course not more than \$800 in all of State funds can be given. The State superintendent, who prescribes most of the requirements to be met, may also appoint an inspector of high schools and private denominational schools, at a salary of \$2,000.

KANSAS.

The session laws of 1911 for Kansas provide a fund of \$25,000 for 1912 and \$25,000 for 1913, to be used in paying bonuses at the rate of \$250 per annum for the maintenance of "courses in the elements of agricultural and domestic science" in high schools maintaining normal training courses under the provisions of a previous act. With this fund it is possible to extend aid for the teaching of agriculture and home economics to 100 high schools. At least 10 pupils



WOMEN'S BUILDING, OKLAHOMA COLLEGE.



FIG. 1.—FOREST-PRODUCTS LABORATORY, UNIVERSITY OF WISCONSIN.



FIG. 2.—CLASS IN STOCK JUDGING, THIRD DISTRICT AGRICULTURAL SCHOOL,
MAGNOLIA, ARK.



FIG. 1.—DINING HALL, THIRD DISTRICT AGRICULTURAL SCHOOL, MAGNOLIA, ARK.

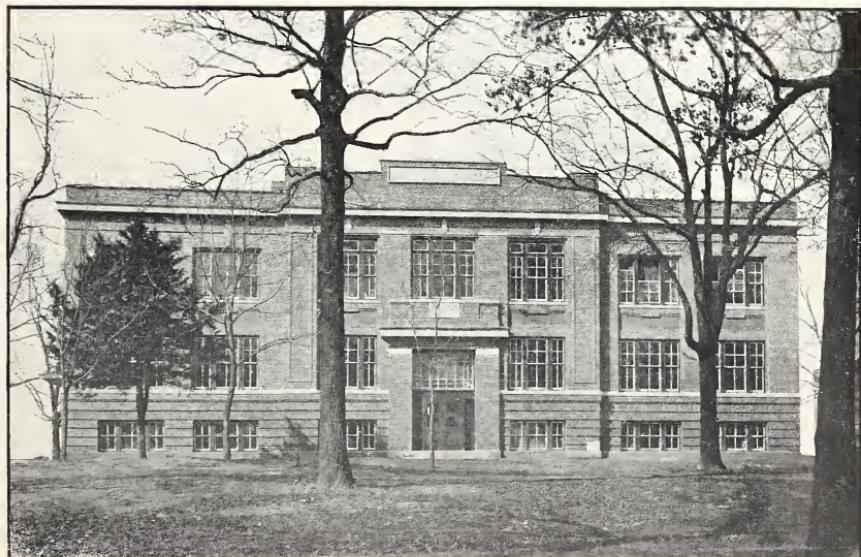


FIG. 2.—MAIN BUILDING, FOURTH DISTRICT AGRICULTURAL SCHOOL, MONTICELLO, ARK.



FIG. 1.—INTERIOR OF CLOTH HOUSE MADE BY THE FARM-MECHANICS CLASS, GARDENA AGRICULTURAL SCHOOL, LOS ANGELES, CAL.

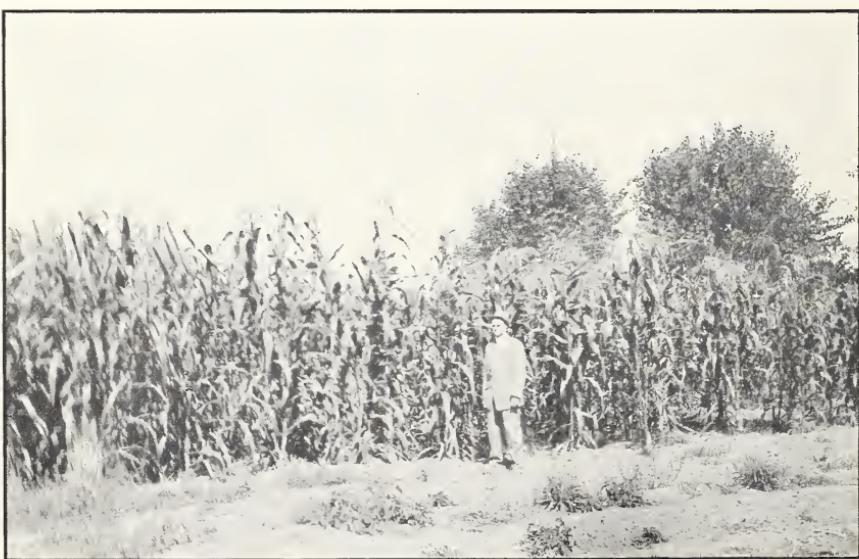


FIG. 2.—EAR-ROW SEED-CORN TEST ON THE BAKERSFIELD (CAL.) HIGH SCHOOL FARM.



FIG. 1.—BOYS MAKING TILE FOR IRRIGATING SYSTEM AT BAKERSFIELD (CAL.) HIGH SCHOOL.

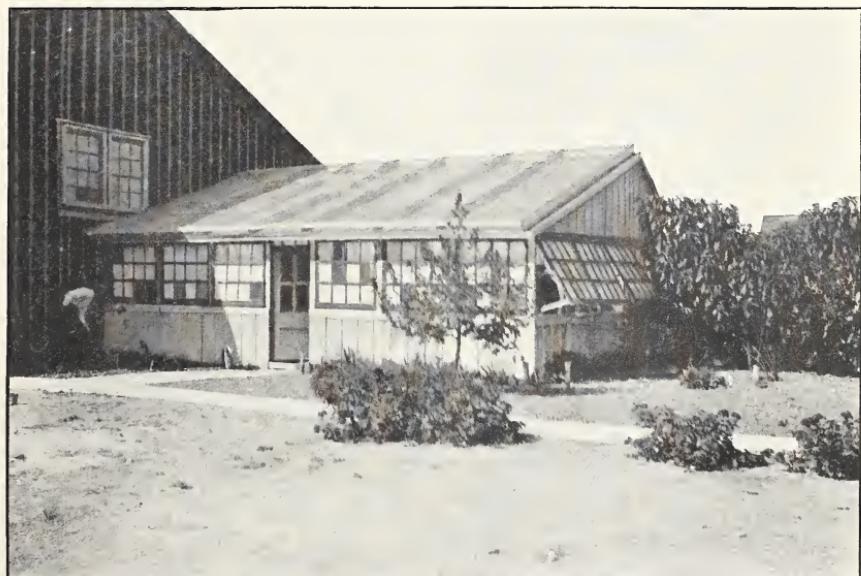


FIG. 2.—GREENHOUSE ERECTED BY THE STUDENTS OF THE OXNARD (CAL.) HIGH SCHOOL.



FIG. 1.—HOME ECONOMICS DEMONSTRATION AT A MOTHERS' MEETING, TULETA (TEX.) HIGH SCHOOL.



FIG. 2.—FARMERS' CLUB MEETING AT TULETA HIGH SCHOOL.

must be enrolled in these courses and a minimum of one year in agriculture and one year in home economics will be required.

LOUISIANA.

Provision is made for an annual State appropriation of \$25,000, to be divided among the high schools maintaining departments of agriculture approved by the State department of education. Such schools must have a demonstration farm of 5 acres, at least \$400 worth of agricultural apparatus, tools, and farm implements, and a teacher who is a graduate of an agricultural college and who shall devote his entire time to the agricultural work. Seventeen high schools have established such departments and are receiving State aid.

MAINE.

The legislature of 1911 amended the act of 1909 providing State aid for instruction in agriculture and other industrial subjects in incorporated academies, so as to make its provisions apply to free high schools as well as incorporated academies. Schools complying with the regulations of the State superintendent of public instruction as to the teaching of these subjects will be reimbursed for two-thirds of their expenditures for instruction in such subjects, not to exceed \$500 in any one year.

MARYLAND.

The agricultural experiment station is cooperating with the Baltimore County school board in conducting experiments and demonstrations with corn, potatoes, fertilizers, spraying, and hay crops. This work has been placed under the immediate supervision of the faculty of the Baltimore County Agricultural High School. This school and 8 other high schools in the State are now receiving State aid for the teaching of agriculture.

MASSACHUSETTS.

An estate of about \$20,000, including about 250 acres of woodland, 8 acres of cleared land, and several farm buildings, has been bequeathed to a board of trustees for use in benefiting the people of Barnstable County agriculturally. Special attention is given to fruit growing, market gardening, and poultry raising. A poultry plant has been provided, gardens and orchards established, and arrangements made for further development. Much of the work has been in close association with the local schools of Sandwich.

The legislature has made it possible for a vocational agricultural school to be established in any existing high school by a town or a group of towns formed into a district. If such a school is approved

by the board of education as to organization, equipment, course of study, and teachers, it will be reimbursed by the State to the extent of two-thirds of the salary paid the agricultural instructors. The appropriation for carrying on this work was \$10,000.

MINNESOTA.

The Putnam Act of 1909 was amended by the State legislature in 1911 so as to permit 30 schools instead of 10 to receive a State bonus of \$2,500 a year for the teaching of agriculture, home economics, and farm mechanics, and appropriating \$75,000 for the purpose of carrying out the amended act.

The legislature also passed what is known as the Benson-Lee Act, giving \$1,000 annually to each of 50 high schools or graded schools maintaining a course in agriculture and a course either in home economics or in manual training. This act is to be administered by rules to be prescribed by the State high-school board, which has laid down the following minimum requirements: The courses to be maintained throughout the school year; a free winter course of not less than three months to be offered; instructors to have had training in their respective lines in technical schools; suitable rooms and equipment to be provided; the instructor in agriculture to have a room exclusively for his work and to have not less than a continuous half day for agricultural work; the instructor in agriculture to study local conditions and attend meetings for the purpose of making the acquaintance of farmers; the instruction in agriculture to include textbook work, laboratory courses, special work along some line of local interest, institute work in cooperation with the extension division of the college of agriculture, and a winter short course; two satisfactory daily periods in an agricultural or industrial subject to count as a credit.

MISSISSIPPI.

Under the act of 1910 authorizing county agricultural schools to be established in each county, 21 schools were in operation during the past year.

NEBRASKA.

The Fairfield High School has adopted a new method in teaching agriculture. The school board arranged for the class, with the teacher, to visit a number of farms adjacent to town. The farmer, if he is in the live-stock business, talks to the class, giving a short history of the particular breed of stock he handles and telling why he believes that breed superior to others. He tells of his method of handling, feeding, and marketing his stock, and gives reasons for the methods employed. Before visiting such a farmer the class gets all the information possible from textbooks and teachers concerning his

particular specialty. The practical talk and demonstration on the farm close the subject. The school board has arranged to have a local expert judge of stock accompany the class whenever it visits a herd of cattle.

The expense of carrying on this field work is practically nothing, as a group of public-spirited citizens has offered the use of their automobiles in taking the class to the various farms and charge merely for the amount of gasoline used in making the trips.

The last legislature appropriated \$100,000 for a new agricultural school, to be located at Curtis on a 20-acre campus within the city limits. It will own and use for demonstration and other purposes a 413-acre farm.

NEW JERSEY.

According to the 1911 laws, one of the deputy commissioners of education will act as inspector of industrial education, including agriculture.

NORTH CAROLINA.

The Legislature of North Carolina passed a law providing for a "county farm-life school" in each county complying with certain provisions of the act. The schools can not be located in any city or town of more than 1,000 inhabitants, nor within 2 miles of any city or town of more than 5,000 inhabitants. The county, township, school district, or all these combined, must provide at least \$2,500 a year for maintenance, and must also furnish equipment consisting of a school building, dormitory buildings for not less than 25 boys and 25 girls, a barn, a dairy building with the necessary equipment, and a farm of not less than 25 acres of good land.

The high-school departments maintained under the present State law are to be conducted in connection with each county farm-life school. The teachers must hold the prescribed high-school teachers' certificates on all required subjects except Latin, Greek, and modern languages. Men must also have certificates from the State board of examiners and the president of the North Carolina College of Agriculture and Mechanic Arts attesting to satisfactory qualifications for their special work, while the women must have similar certificates from the State board of examiners and the president of the State Normal and Industrial College. Provision is to be made in these schools for regular courses in agriculture and home economics, and also for extension and demonstration work and short courses for adult men and women.

A school meeting all of the requirements imposed by this law may receive from the State \$2,500 annually for maintenance, except that not more than 10 schools may be established in any one year and not more than one such school in any county.

The superintendent of schools in Wake County, N. C., assisted by the Women's Betterment Association of the county, successfully inaugurated 11 school farms, each having an area of about 2 acres, and planted to cotton, tobacco, corn, and wheat. These are conducted in connection with rural schools and are worked by both children and adults, each workday on the school farms being made a social event. Over 1,200 persons have participated in the work.

NORTH DAKOTA.

An act approved March 18, 1911, provides that any high school, graded, or consolidated rural school having facilities to do agricultural work and maintaining an agricultural department shall receive \$2,500 a year of State aid, provided, however, that the number of schools the first year be limited to five and that an additional number of not more than five may be added every two years. Owing to a veto by the governor of the provisions to carry out this act for 1912, there will be no funds for these schools until 1913. Provision was also made for county agricultural and training schools.

OHIO.

The General Assembly of Ohio passed a bill requiring that agriculture be taught in all the common schools of that State except those in city school districts. This bill also provides for dividing the State into four agricultural districts and the appointment by the State commissioner of common schools of a superintendent of agricultural education for each district.

"Four years ago," according to G. A. Bricker, "there were but four high schools in Ohio that taught the subject of agriculture; to-day there are 270 high schools that teach it."

PENNSYLVANIA.

The new school code of 1911 provides that agriculture shall be taught in township high schools; also that a portion of the income of the State school fund may be used "to promote education in conservation, forestry, and agricultural and industrial pursuits."

TEXAS.

The Bonham High School took advantage of the provision for State aid for teaching agriculture, manual training, and home economics, enlarged and equipped laboratories for the work, and purchased $5\frac{1}{2}$ acres of land adjoining the school. The first-year students have complete charge of the school farm, and upon them rests the responsibility of preparing the ground, selecting the seed, planning the rotations,

and planting the various crops. They have five recitations from the textbook in agriculture each week, and each afternoon one division of the class goes to the field.

The farm is divided into one-fifth and one-tenth acre plats. Each plat is permanently staked and numbered, and the boys have drawn a large map and made blue prints of the farm. Under the direction of the manual training teacher they have built a house 16 by 30 feet, with a loft capacity of about 6 tons. This is being used for the storage of implements, tools, seeds, and produce, as well as for class work in seed testing, grading, and all other indoor activities of the farm.

One or more of the following crops have been planted: Cotton, corn, oats, barley, emmer, rape, millet, Kafir corn, broom corn, mangels, cowpeas, velvet beans, soy beans, peanuts, cabbage, onions, tomatoes, beets, and bush beans. Other crops, such as alfalfa, vetch, bur clover, crimson clover, rye, wheat, and winter oats are included in the rotations for fall sowing.

A few simple experiments have been planned and are being carried out, such as the use of acid phosphate on cotton, and lime on alfalfa, leaving cotton thick and thin in the row, etc. In most of the work the school is aiming to demonstrate principles that have already been established. The following are some of the demonstrations that have been undertaken: (1) That barnyard manure is valuable and should be utilized, (2) that crop rotation is a necessary feature in successful agriculture and that legumes should occupy a prominent part in these rotations, (3) that winter cover crops are essential in retaining soil fertility in the South, (4) that improved seeds are important for high yields and should be selected annually from the growing crop, (5) that early surface cultivation for conservation of moisture is necessary as a safeguard against possible drought in July and August, (6) that deep plowing rather than shallow is necessary on upland soils to retard erosion, and (7) that the better cultivation of fewer acres and diversified farming involves less risk, distributes the work more uniformly throughout the year, and in the end is more profitable than straight farming to cotton and corn. The boys do all the work and seem glad of the chance to do something from which they can see immediate results.

The high school at Tuleta, Tex., is another of the few agricultural and industrial high schools in Texas receiving the statutory aid of \$2,000 per annum. The school campus of 20 acres was donated by two farmers and the school building was likewise a gift from the community to the Tuleta school district. This commodious and comfortable building was erected on the cooperative plan, each citizen contributing what he could in money, materials, labor, or other commodities. About half the land is in good state of cultivation, the other half is used as playgrounds.

The manual training and domestic science outfits, costing about \$164, were likewise largely contributed through the united and intelligent efforts of the neighborhood. In fact, cooperation seems to be a characteristic of the community. The mothers of the community are loyal supporters of the school in all its suggestions and requests. They furnish all the material for their own cooking demonstrations which occur each Friday afternoon. (Pl. XV, fig. 1.) Some of the different phases of home economics discussed at these meetings are, labor-saving devices, food adulterations, sanitation, diseases common to rural communities, and many other subjects equally valuable.

Very often class assemblies are held on Friday afternoons. The program may consist of a discussion of (1) some great achievement of the past or present, (2) some phase of agriculture, or (3) history. After these exercises the mothers go to the school kitchen where the teacher in charge gives a demonstration on some problem connected with her work. Then follows a social hour, or perhaps a talk on some feature of school work, or some topic relating to both the home and the school. After this they visit the boys at work in the wood shop and there come into personal touch with the teacher and his work. They are also given the opportunity to read the current literature upon the library table and draw books for home reading.

UTAH.

The State board of education of Utah has provided that every accredited high school in the State must teach agriculture in order to participate in the maintenance fund provided for high schools.

The 1911 legislature provided for the establishment of an experiment station at the Panguitch School, in Garfield County, formerly an Indian school, also for the teaching of agriculture at the school.

VERMONT.

The Legislature of Vermont passed a bill establishing a State school of agriculture with an appropriation of \$20,000 for buildings, repairs, and equipment, and \$10,000 annually for maintenance. The bill also makes provision for the discontinuance of the State Normal School at Randolph, and the transfer of its property to the trustees of the new school of agriculture. This gives the school a fairly good equipment of buildings and it is understood that suitable land can be procured in the vicinity. The agricultural school at Lyndonville had a full attendance and a successful year.

WISCONSIN.

An act of the legislature of 1911 provides for State aid of \$250 for each department of manual training, home economics, or agriculture

established in connection with any free high school. If the same department extends to three grades below the high school, this sum is increased to \$350.

AGRICULTURE IN STATE NORMAL SCHOOLS.

Of the 185 State normal schools in the United States, 104 offered courses in agriculture during the year; 6 others, courses in school gardening; and 12, not counted in the 110 preceding, in nature study.

The courses offered vary from four weeks in some of the schools to three-year and four-year courses in others.

The work at North Adams (Mass.) State Normal School extends over three years and includes a study of the problems most closely concerned with the growing of farm crops, a special study of horticulture as well as poultry and dairying.

The Central State Normal School, Mount Pleasant, Mich., conducted a five-day institute on agricultural and rural topics. The heads of the departments of chemistry, bacteriology, soils, horticulture, and forestry of the Michigan Agricultural College and members of the agricultural and home economics faculty of the normal school discussed their subjects in relation to the rural schools, and a representative of the State grange dealt with the new rural sociology. There were also discussions of the new rural spirit and conferences on various subjects taught in the rural schools.

The Third District Normal School, at Cape Girardeau, Mo., in addition to its regular courses for teachers, is conducting (1) a four-year secondary course intended to fit young men either for farm life or to enter an agricultural college, (2) a boys' short course, running six weeks in winter and confined to farm mechanics and agricultural science, and (3) a school for farmers, lasting from 10 days to 2 weeks.

The State Normal and Training School at Cortland, N. Y., announced courses for teachers beginning with the fall of 1911. Two courses are available, (1) a two-year course open to men at least 16 years of age who have had farm experience and the necessary training to admit them to the regular normal-school courses, and (2) a one-year course open to young men who are high-school graduates or have had equivalent education, have had farm experience, hold a life certificate valid in New York, and have had at least one year of successful experience in teaching. Both courses are primarily scientific and agricultural, but the two-year course includes one unit of psychology, one of the history of education, two-fifths of a unit of school economy, one unit of manual training, one of grammar methods, and two each of observation and teaching. The work in science and agriculture, which is common to both courses, includes agricultural physics, farm mechanics, horticulture, farm crops, animal husbandry, dairying, farm management and farm practice,

botany, entomology, bacteriology and plant pathology, advanced science methods, and chemistry. The purpose of the courses is to train teachers for high-school work in agriculture under the New York State law giving State aid to schools organizing departments of agriculture, home economics, and manual training.

THE ELEMENTARY SCHOOLS.

There has been continued effort on the part of many agencies to promote the various phases of elementary agriculture in the common schools. The Legislature of Ohio passed a law requiring the teaching of agriculture in all elementary schools and rural high schools and provided for the appointment of four supervisors for this work. New York is inaugurating a system of rural-school supervision for nature study and elementary agriculture. In Oregon a new law provides that the counties shall be divided into supervisory districts of 20 to 50 schools, and district supervisors who will promote the teaching of agriculture are being employed at from \$100 to \$120 a month and traveling expenses. In North Dakota the legislature provided for State aid to rural schools teaching agriculture. In nearly all of the Southern States rural-school supervisors appointed two or three years ago have been actively promoting the teaching of agriculture. School gardens have increased in number, especially in the cities and towns, and a national association of school-garden teachers was formed. Boys' encampments with agricultural features have been held at State and county fairs and out in the open country. Boys' and girls' rural-life clubs have increased rapidly in number, variety, and membership.

Boys' corn clubs under the auspices of this department and the State agricultural colleges have been extended over 13 Southern States, with a membership this year of 55,000. There are also 1,400 members of boys' cotton clubs and nearly 5,000 members of girls' garden and canning clubs, making fully 60,000 members of these various clubs.

In December, 1910, the 11 State winners in the boys' corn-growing contest in the South were given a free trip to Washington, where they were entertained by President Taft, the Secretary of Agriculture, who gave each boy a diploma of merit, and by Members of Congress and others. The expenses of their trip were met by local contributors, bankers, merchants, and others interested in the improvement of agricultural conditions in the South.

The boys brought to Washington were from 10 to 16 years old and each had planted, cultivated, and harvested 1 acre of corn, with a larger yield than that secured by any other boy in his State. The names of the 1910 winners of State prizes, the States in which they live, and the yield of each prize acre are given in the table following.

Records of State prize winners, 1910.

Winners.	Yield per acre.	Cost per bushel.	Depth of plowing.	Number of cultivations.
	Bushels.	Cents.	Inches.	
Hughay Harden, Alabama.....	120	32	14	6
Ira Smith, Arkansas.....	119	8	14-16	5
Joseph Stone, Georgia.....	102 $\frac{5}{8}$	29	12-15	5
Stephen Henry, Louisiana.....	139 $\frac{1}{2}$	13.6	12	8
William Williams, Mississippi.....	146 $\frac{1}{2}$	18	12	6
Ernest Starnes, North Carolina.....	146 $\frac{1}{2}$	27	8-10	8
Floyd Gayer, Oklahoma.....	95. $\frac{1}{2}$	8	12	7
Jerry Moore, South Carolina.....	228 $\frac{1}{2}$	43	10-12	11
Maurice Olgers, Virginia.....	168	40	12-15	5
Norman Smith, Tennessee.....	125 $\frac{1}{2}$	37	10	5
Rodger Smith, Texas.....	83 $\frac{1}{2}$	13 $\frac{3}{4}$	8	5
Archie Odom, South Carolina.....	177	23	15	6
John Williams, Alabama.....	83 $\frac{1}{2}$	49	19	6

The club movement has been developing in other parts of the United States longer than in the South, but in no large section has it made more rapid progress. One of the most fully organized States is Nebraska, where boys' and girls' club work has been active for a half dozen years at the least. The variety of work done in that State is indicated by the following topics taken from bulletins of instruction prepared by the faculty of the college of agriculture and sent by the State department of public instruction to members of the clubs: "Course in cookery for Nebraska girls' domestic science clubs," "General outline of plans for the Nebraska boys and girls' club," "How to test seed corn," "Directions for planting the ear to row test with corn," "The size of seed piece experiment with potatoes," "Suggestions on acre contest and sweet pea culture," "Directions for sewing," "Recipes for cooking," "Sweet pea culture for Nebraska boys and girls' club," and "Some common weeds and insects of Nebraska cornfields and potato patches."

In Massachusetts potato clubs were organized in 1908 by Prof. W. R. Hart, of the Massachusetts Agricultural College. The first year there were about 600 club members, in 1910 there were 5,200, this year over 10,000. Each boy who wishes to join a club writes a letter promising to plant, cultivate, and dig the potatoes without any help. In return for this promise he receives four seed potatoes and a chance to contest for a prize.

Prof. Hart is also directing a "potato-culture club" or "experiment club" of about 200 members, who are engaged in selecting potatoes for the purpose of improving the quality and increasing the yield. The best tubers from the highest yielding hills are planted each year, and the result is an improved tuber both as to edibility and productiveness.

And so the movement is developing, with a great variety of enterprises and a rapid increase in club membership. In Oregon there

are truck gardening clubs; in California, garden city clubs, with their accompanying banks and city government organizations; also in California, tree-growing clubs; in North Dakota, agricultural and home economics clubs, with short courses at the agricultural college as prizes; in Texas and Louisiana, hog clubs; and in many other States similar organizations with their accompanying exhibits, judging contests, study of reliable literature, and other educational features—all exceedingly popular, but withal sane and sure to exert a powerful influence upon the coming generation for the development of a sturdy and intelligent manhood and womanhood and the upbuilding of rural life and institutions.

CONNECTING THE SCHOOL WITH THE FARM HOME.

A unique scheme for promoting more sympathetic and helpful relations between the rural school and the farm home is reported from Oregon. Credit for the project is due to L. R. Alderman, State superintendent of public instruction, who has outlined his plans as follows:

That civilization is founded on the home all will agree. The school should be a real helper of the home. How can the school help the home? How can it help the home establish habits in the children of systematic performance of home duties, so that they will be efficient and joyful home helpers? One way is for the school to take into account home industrial work and honor it. It is my conviction, based upon careful and continuous observation, that the school can greatly increase the interest the child will take in home industrial work by making it a subject of consideration at school. A teacher talked of sewing and the girls sewed. She talked of ironing, and they wanted to learn to iron neatly. She talked of working with tools, and both girls and boys made bird houses, kites, and other things of interest. A school garden was planned in a city, and one of the boys was employed to plow the land. Seventy-five children were watching for him to come with the team. At last he came driving around the corner. He could manage a team. He drove into the lot, and 150 eyes looked with admiration at the boy who could unhitch from the sled and hitch on to the plow, and then as he, "man fashion"—lines over one shoulder and under one arm—drove the big team around the field, all could feel the children's admiration for the boy who could do something worth while. I have seen a girl who could make good bread or set a table nicely get the real admiration of her schoolmates.

The school can help make better home builders. It can help by industrial work done in the school, but as that is already receiving consideration by the press and in a few schools, I shall not in this short article treat of it.

The plan I have in mind will cost no money, will take but little school time, and can be put into operation in every part of the State at once. It will create a demand for expert instruction later on. It is to give school credit for industrial work done at home. The mother and father are to be recognized as teachers, and the school-teacher put into the position of one who cares about the habits and tastes of the whole child. Then the teacher and the parents will have much in common. Every home has the equipment for industrial work and has somebody who uses it with more or less skill.

The school has made so many demands on the home that the parents have, in some cases, felt that all the time of the child must be given to the school. But an important thing that the child needs along with school work is established habits of home-making, and these habits can come only from real home-making. What one does depends as

much upon habit as upon knowledge. The criticism that is most often made upon industrial work at school is that it is so different from the work done at home that it does not put the child into that sympathetic relation with the home which, after all, is for him and the home the most important thing in the world. Juvenile institutions find that they must be careful not to institutionalize the child to the extent that he may not be contented in a real home. In my opinion it will be a great thing for the child to want to help his parents do the task that needs to be done and to want to do it in the best possible way. The reason that so many country boys are now the leading men of affairs is because early in life they had the responsibility of home thrust upon them. I am sure that the motto, "Everybody helps," is a good one.

But one says, "How can it be brought about? How can the school give credit for industrial work done at home?" This may be accomplished by printed slips asking the homes to take account of the work that the child does at home under the instruction of the home, and explaining that credit will be given this work on the school record. These slips must be prepared for children according to age so that the child will not be asked to do too much, for it must be clearly recognized that children must have time for real play. The required tasks must not be too arduous, yet they must be real tasks. They must not be tasks that will put extra work on parents except in the matter of instruction and observation. They may well call for the care of animals, and should include garden work for both boys and girls. Credit in school for home industrial work (with the parents' consent) should count as much as any one study in school.

To add interest to the work, exhibitions should be given at stated times, so that all may learn from each other and the best be the model for all. The school fairs in Yamhill, Polk, Benton, Lane, Wasco, and Crook Counties, together with the school and home industrial work done at Eugene, have convinced me most thoroughly that these plans are practicable, and that school work and home work, school play and home play, and love for parents and respect for teachers and fellow pupils can best be fostered by a more complete cooperation between school and home, so that the whole child is taken into account at all times.

That the plan is practicable is indicated by a report made by A. I. O'Reilly, principal of the Spring Valley school, near Salem, Oreg. Under the home credit plan there in operation any pupils who desire to enter the contest may do so and compete for prizes, which, in this instance, include three \$3 prizes and three \$2 prizes which are placed in the bank to the account of the winners.

The plan is to offer so many minutes' credit for each little task which the pupils perform about the house. For example, if the boy or girl builds the fire at home in the morning he is given 5 minutes' credit; milks a cow, 5 minutes for each cow; splits and carries in the wood, a 12-hour supply, 10 minutes; turns cream separator, 10 minutes; cleans horses, 10 minutes for each horse; gathers the eggs, 10 minutes; feeds chickens, cows, pigs, horses, 5 minutes for each kind of animal. For churning butter, 10 minutes are allowed; making butter, 10 minutes; blacking stove, 10 minutes; making and baking bread, 1 hour; making biscuits, 10 minutes; preparing breakfast for family, 30 minutes; preparing supper, 30 minutes; washing and wiping dishes, 15 minutes for each meal; sweeping floor, 5 minutes for each floor; dusting furniture, 5 minutes for each room; scrubbing floor, 20 minutes for each room; making beds, 5 minutes

a bed; sleeping in room with window open, 5 minutes; bathing, 30 minutes for each bath; and a number of other classes of work are included.

The one who has the most minutes to his or her credit at the end of a specified time is awarded the prize.

The parent or guardian of each pupil is instructed to send an itemized statement of the work done. For instance, Rebecca Lenstrom is shown by a letter of her father to have fed the chickens, gathered the eggs, built the fires, made two beds, prepared supper, washed and wiped the dishes, swept and dusted two rooms; and at that went to bed at 9 o'clock. She also prepared breakfast, washed and wiped the dishes; and washed her teeth. She is 14 years old.

Her sister, Lulu, 6 years old, fed the chickens one morning and washed her teeth. For this work the girls were given certain credits toward the prizes.

Mrs. H. N. Alderman's child went to bed at 9 o'clock, this being one of the provisions, milked the cow night and morning, fed the chickens two times and separated the milk once, being given 35 minutes' credit for the work. Maynard Cochran, 5 years old, cleaned the barn and swept the kitchen in an effort to secure the prizes. Numerous other reports of a similar nature have been forwarded to us by Mr. O'Reilly, all of which indicate a growing interest in the work by both pupils and parents. Commenting on the credit allowances, Mr. O'Reilly writes:

You can see that it is not my intention to give them full credit for the time necessarily spent in home work. I have learned that this world does not give us full credit for our time. Had I learned it when I was younger I believe I would be a better man to-day. I have explained and demonstrated this to my school, thus preparing them early to learn to give more than they get. The plan is an agreement between each pupil and me. If he fails to live up to his part of it he should learn that the violation of his agreement always works a hardship. Perhaps I am teaching some practical business law here.

The plan of the awards starts them on a commercial future and has resulted in my having to tell them all about savings accounts.

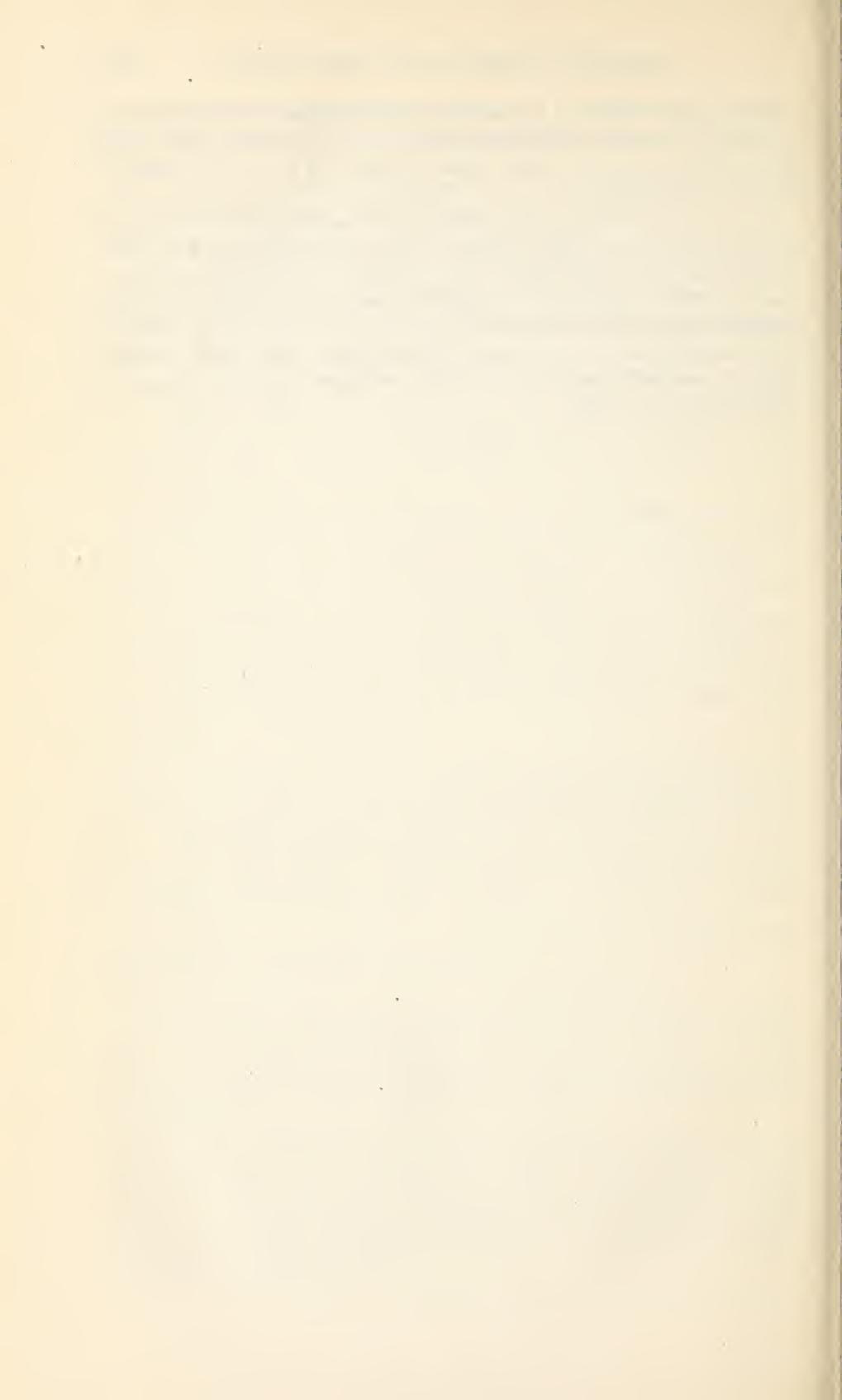
I have 33 pupils and receive 33 notes each morning from the parents.

Under the rules as adopted no pupil is required to enter the contest. Any pupil entering is free to quit at any time, but anyone quitting without good cause will lose all credits. Every day the teacher issues a credit voucher to the pupil showing the number of minutes for which he is credited.

Ten per cent credit is added to final examinations for the credit of pupils who enter and continue the contest. When the pupil has vouchers to the extent of one day earned, by their surrender to the teacher he may have a holiday, provided not more than one holiday is granted to a pupil a month.

If the pupil drops out or has an unexcused absence he forfeits all credits, for unexcused tardiness he forfeits 25 per cent of the credits, and forfeits 10 per cent when he has less than 90 per cent for deportment for the month.

All in all, the Oregon plan appeals to us as being worthy of quite general trial in the public schools. The lack of training for school children in the homely duties—the “chores” of the farm and home—has been much deplored by thoughtful educators, and any reasonable plan like this which will encourage parents to teach their children what they know about cooking, sewing, farm work, and personal hygiene, and will stimulate an interest in these things on the part of children, is worth while.



THE FARMERS' INSTITUTES AND EXTENSION WORK IN THE UNITED STATES, 1911.

By JOHN HAMILTON.

Farmers' Institute Specialist, Office of Experiment Stations.

The farmers' institute season which closed June 30, 1911, registered a larger attendance than any previous year. The reports show that institutes were held in all of the States and Territories excepting Nevada, Alaska, Hawaii, and Porto Rico. Although no institutes are reported for New Mexico, nevertheless local meetings were held at which members of the agricultural college faculty and of the experiment station staff gave instruction.

INSTITUTES HELD.

The total number of institutes held during the year was 5,889. These were made up of 3,948 one-day meetings, 1,727 two-day, and 214 three or more day, an increase over the previous year of 409 one-day meetings and 42 three-day. There was a falling off in the two-day meetings of 213. The whole number of days of institutes held in 1911 was 8,045, an increase of 110 over the year 1910.

SESSIONS.

The number of sessions was 16,741, or 155 more than were held in 1910. These sessions were each a half day or an evening in duration and, taken in connection with their average attendance, indicate the progress of the work more accurately than the total number of institutes held or their aggregate attendance.

ATTENDANCE.

The entire attendance reported at all regular institutes was 2,291,857, with an average attendance per session of 138. This shows a falling off of 104,051 in general attendance and of 6 in the average per session. The States in which the greatest falling off occurred are: Arkansas, 20,909; Colorado, 15,443; Illinois, 67,001; Louisiana, 15,730; Maine, 4,953; Montana, 5,897; New Jersey, 2,805; Ohio, 45,855; Oklahoma, 74,680; South Dakota, 35,400; Tennessee, 4,768; Utah, 24,628; Virginia, 16,000; Washington, 8,505; Wyoming, 3,430; a total of 346,004.

The States showing the largest gain in attendance during the year are: Arizona, 3,132; California, 4,930; Florida, 11,039; Iowa, 20,153; Kansas, 48,460; Kentucky, 60,323; Maryland, 4,809; Mississippi, 15,631; Missouri, 49,527; New Hampshire, 3,800; North Carolina, 9,385; North Dakota, 9,711; Oregon, 7,270; South Carolina, 18,000; Texas, 20,122; Vermont, 2,476; a total of 288,767.

APPROPRIATIONS.

The appropriations from all sources in 1911 were \$432,693.47. The appropriations from the State legislatures for institute purposes were \$367,876.22, and the amount received from other sources was \$65,317.25. The amount expended for institute purposes was \$418,406.06, or \$14,287.41 less than was appropriated.

AGRICULTURAL COLLEGE AND EXPERIMENT STATION AID.

Thirty-five of the agricultural colleges and experiment stations furnished from their faculties and staffs 345 lecturers, who devoted to institute service in the aggregate 4,259 days of time, or an average of 12.3 days each.

Comparing the 34 States that furnished reports upon college service for both years, there were 337 lecturers in 1911 as against 368 in those same States in 1910, or a falling off of 31 in 1911. The lecturers, however, in 1911, gave in the aggregate 4,214 days of service as against 3,700 by the larger number in 1910. More time, therefore, was given to the institutes by the colleges reporting in 1911 than they gave the previous year by 514 days.

SPECIAL INSTITUTES.

The attendance at the special institutes has more than doubled during the year. Movable schools of agriculture and domestic science were held in 14 States. The total number of schools held was 168, covering 659 days and attended by 48,465 persons.

Twenty-eight States ran 71 educational trains or railroad specials. Seven hundred and sixty-seven lecturers accompanied these trains. Forty thousand three hundred and five miles were run, 2,106 stops were made, and 995,220 people were in attendance.

Eleven States report independent institutes to the number of 459, embracing 574 sessions and attended by 130,917 persons. Sixteen round-up institutes were held by 13 States, embracing 162 sessions and attended by 23,730 persons.

Three hundred and ten picnics and fairs were visited and addressed by institute lecturers, with a total attendance of 125,361. The aggregate attendance at all of the special institutes as reported was 1,323,-

693, making the entire attendance at institutes of all kinds for the year 3,615,550, an increase of 682,306 over the year before.

This large addition is due chiefly to the increased number of railroad instruction trains run in 1911. In 1910, 29 trains were run by 19 States, with an attendance of 189,645 persons. In 1911, 71 trains were run by 28 States, attended by 995,220 persons, an addition of 9 States, 42 trains, and in attendance 805,575.

The very marked attention that is being given to special institutes as shown by their number and attendance is indicative of a disposition on the part of the institute directors to make their work more specific than formerly by devoting to instruction in one or two important items in farm operations periods that once were occupied by the discussion of numerous topics. The railroad potato special, hog special, and wheat special, the movable school, the corn-judging contest, etc., are examples of this specialization. The slight falling off also in the number attending the regular institutes is suggestive of the need for some such change as these figures indicate if public interest is to be maintained.

AGRICULTURAL COLLEGE EXTENSION WORK.

Data collected by the institute office relative to the progress of extension activities by the agricultural colleges and experiment stations during the year have been tabulated and were presented in a report made to the Association of American Agricultural Colleges and Experiment Stations at their meeting in Columbus, Ohio, November, 1911.

Information more or less complete was received from 45 of the agricultural colleges and experiment stations representing 43 States in which extension work is conducted. In 43 institutions directors of extension have been appointed. Eight of these are also directors of the experiment stations, leaving 35 institutions with extension directors giving their time in whole or in part to this work. In 27 States there are 109 men devoting all their time to extension. In 29 States 256 are reported as giving part of their time to extension teaching and to other forms of extension activity. In 10 other States the members of the colleges and station staffs gave part of their time to extension work, but the number so employed is not designated. In 28 States 160,073 persons were registered as regular students of extension classes and in 21 States 1,230,940 are reported as miscellaneous or in irregular attendance. There was appropriated \$397,573.42 in 37 States for extension work in 1910-11 and \$427,628.71 was expended by 36 States. For the college year 1911-12, \$584,171 has been appropriated by 37 States.

The States in which the highest number of extension workers are employed for the entire year are Iowa, Kansas, and Ohio—17, 16, and

12, respectively. There were 8 in Massachusetts, 7 in Minnesota, and 5 in Utah. Three States have 4, 2 have 3, 10 have 2, and 16 have 1.

The States receiving the largest appropriations are Iowa and New York, \$50,000 each; Indiana, \$49,200; Minnesota, \$42,000; Ohio and Wisconsin, \$40,000 each; Kansas, \$35,000; Georgia, \$30,000; Massachusetts, \$20,000; Illinois, \$19,900; and Nebraska, \$17,500. Ten States gave from \$10,000 to \$16,000 for extension work, 8 from \$5,000 to \$10,000, 6 from \$2,000 to \$4,500, and 1 State gave \$1,900 and another \$600.

When it is remembered that only six years ago there were scarcely a half dozen institutions in the entire country having organized systems of extension work in agriculture, the present advanced position that the work occupies in the general system of agricultural education is the more remarkable. Appreciation of the importance and extent of the new field of work of the colleges and experiment stations is now general. There are needed for its full development proper methods for imparting the information, a supply of expert teachers and advisers to meet and instruct the people, and sufficient funds to defray the expense involved.

AMERICAN ASSOCIATION OF FARMERS' INSTITUTE WORKERS.

The American Association of Farmers' Institute Workers held its sixteenth annual meeting at Columbus, Ohio, November 13 and 14, 1911. Forty States, three of the Provinces of Canada, and the District of Columbia were represented by accredited delegates.

The importance of this association is in the fact that it represented an attendance upon institute instruction during the year of about 4,000,000 people, 3,600,000 of whom were in the United States; that it is virtually responsible for the expenditure of about a half million dollars annually in disseminating agricultural information among rural people, and that it employs a teaching force during the institute season numbering 1,100 skilled lecturers besides a much larger number of local speakers who present papers before the institutes and participate in the discussions.

The program for the meeting, outside of the reports of the standing committees, provided for the discussion of four groups of topics, assigning a full half day or evening session to each group. There was a general session at which five questions that had been assigned to as many speakers for opening papers were discussed, each followed by a discussion led by a second speaker and then thrown open to the convention for three to five minute remarks.

The standing committee reports were upon institute organization and methods; institute lecturers; cooperation with other educational agencies; movable schools of agriculture; boys' and girls' institutes;

and women's institutes. The annual reports of these committees together exhibit the nature and progress of the farmers' institute work since its inception. Their investigations cover quite completely the field of institute activity and their reports are usually followed by recommendations for the improvement of the work. This year the reports may be summed up by the following statements:

(1) That an efficient, permanent, local institute organization in each county is essential to the best conduct of the work.

(2) That lecturers equipped with practical experience as well as scientific knowledge are most appreciated and accomplish the best results.

(3) That the institute is the field agent for the spread of information that other organizations wish to have the public understand and put into practice. Consequently, the institute is under obligation to cooperate with all other agricultural institutions and societies that it may serve them most efficiently.

(4) That the movable school of agriculture is no longer an experiment, but a method of education to be generally adopted and extended.

(5) That institutes for young people, particularly those between the ages of 14 and 18, are recommended to all institute directors for organization, and

(6) That institutes for women have been successful wherever tried and that they should be established in all the States upon equality with those organized for men, both as to financial support and lecture service.

The discussions at the general session related to plans for "following up" institute instruction; the use of a single topic for presentation before all institute assemblies in the United States and Canada during the coming year; the number of lecturers that should be supplied by the State to each institute; the proportion of State appropriations that should be used for local expenses; and the practicability of holding institute meetings monthly during the year.

The second group of topics was upon methods of work. Under this head were discussed effective methods for conducting institute trains, the organization for field demonstration work, and the establishing of winter schools of agriculture and domestic science for adults.

The other group or period was devoted to topics relating to the work and duties of the State directors. Under this head there were three papers, one discussing the organization of a central department of institute control in each State. The next, the duties of the State director and his relation to the local manager. The third topic defined the leading purpose of the annual round-up institute.

The evening session of the last day was devoted to the consideration of the condition of the negro farmers of the South. The discuss-

sion of this topic was directed by the association at its meeting in Washington in 1910. Eight papers were presented treating different phases of this question. The general view expressed was that the condition of the negro farmer, while far below what is desired or what he is capable of accomplishing, was gradually improving and census data as well as specific instances were given to sustain this declaration.

The reports from the States and Provinces showed increase in attendance and interest everywhere during the year; also that the demand for additional institute service has been so insistent and general that the directors are greatly embarrassed in endeavoring to meet these numerous requests. The only relief seems to lie in larger appropriations by the States and Provinces and a considerable increase in the number of well equipped and experienced lecturers.

A complete stenographic report of the meeting was made to be used in preparing the proceedings for publication.

The officers elected for the coming year were: Franklin Dye, of New Jersey, president; F. H. Rankin, of Illinois, vice president; John Hamilton, of this department, secretary-treasurer. The executive committee are J. H. Miller, Kansas; W. J. Black, Manitoba; and Mrs. F. L. Stevens, North Carolina.

FARMERS' INSTITUTES FOR YOUNG PEOPLE.

Institutes for young people were held in 6 States for a total of 199 days. The attendance in 4 of the States reporting was 25,737. These States are Florida, 32 sessions, attendance 3,000; Kentucky, 70 sessions, attendance 8,750; Nebraska, 37 sessions, attendance 8,484; South Dakota, 24 sessions, with an attendance of 5,500.

Four States conducted 23 movable schools for young people, continuing through 75 days, or an average of a little over three days to each school. The attendance is given by only one and in that the number was 244.

It is difficult to understand why institutes for young people are not held by the directors in all of the States. The need is certainly great for work of the kind that the institute offers and the phenomenal success of the corn and garden demonstration work wherever it has been conducted shows that young people are responsive to efforts for their improvement in agriculture if opportunity is presented.

There is danger that the old-time institute, owing to its routine character and the ease with which it can be conducted, may stand in the way of its own development—of the extension of the work to include other forms of effort and grades of rural people. It is important that the institute directors realize that unless their work is constantly expanding to meet the new demands and the new condi-

tions, it will certainly retrograde and eventually cease to be a factor in the betterment of country life.

To fall into routine methods is not only enervating to the individual in charge, but will undoubtedly end in the complete destruction of the organization if these stereotyped methods are continued. In some States there are already signs of lack of vitality in institute work. There is little originality of method shown or aggressiveness of effort. For years the same forms have been maintained and frequently the same antiquated methods of teaching are being followed. The new and fresh ideas that are now being put into use in reaching rural people are coming largely from outside, as is evidenced in the case of the field demonstration, the agricultural survey, the itinerant adviser, and similar modern methods. The institute should lead the way in all of these and other directions in meeting the needs of country people and not await the demonstration of their value by others before undertaking to utilize them in their work of securing a better agriculture and a better country life.

WOMEN'S INSTITUTES.

Fourteen States report separate institutes for women to the number of 312, occupying 374 days, or 577 sessions, with a total attendance of 47,962. The largest number of institutes was held by North Carolina—174, comprising 346 sessions and an attendance of 22,319. Wisconsin is second with 83 sessions and an attendance of 7,500. Michigan, 48 sessions and an attendance of 4,912; Delaware is fourth, with 29 sessions and an attendance of 4,475.

Fourteen States conducted 168 movable schools; 8 of these States held similar schools for women to the number of 48, extending through 208 days. The attendance as reported by four of these States was 1,516.

Whenever opportunity was afforded and proper attention given to the development of the work, women's institutes have been organized, and wherever they have been organized they have been well attended and the effort appreciated. That they would be attended and appreciated generally is evidenced from the fact that east, south, and west women's institutes are successfully held, showing that the claim of some directors that country women in their States are not desirous of separate institutes is groundless, for wherever they have been thoroughly tried they have succeeded, and in Ontario, Canada, they now far surpass those for men both in number of meetings and in attendance. Their success is no longer problematical, and State directors who have not yet organized institutes of this character are missing an opportunity for usefulness that seldom comes to a public official.

EXHIBITS AT FAIRS.

That the agricultural fair presents an opportunity to the farmers' institute for rendering service to agricultural people not fully appreciated is evident from the little attention that the institute has hitherto manifested in this institution. The farmers' institute, standing as it does for advanced agriculture, ought to be represented at these exhibitions by some visible demonstration of its ideals and teachings. If the institute can show valuable results secured by the methods it advises, its influence for the betterment of agriculture will be greatly strengthened and its teaching will be more generally accepted and adopted.

If therefore the institute were to undertake systematically a line of demonstrations for the orchard, stable, and in household economics that could be shown at State and county fairs, exhibiting the results obtained from following the teachings for the improvement of agriculture and the rural home that the institute offers, it would add materially to its value as a public educator and would reach a much larger number than has been possible through the institute assembly. The records show that in 1909 there was an attendance upon the county fairs of 15,791,000 persons. Most of these people could have been reached through suitable exhibits by the farmers' institutes.

Whatever is shown should be accompanied by a skilled exhibitor to call attention to its character and the method of its production. It should also be well advertised throughout the grounds by placards in large letters calling attention to the fact that this display is on exhibition and where the exhibit may be found and that the exhibitor will give full information respecting its character.

Where the exhibit is sent out by the State institute department, it should contain more than one or two articles if it is to be commensurate with the dignity and importance of the department. A plan that has been adopted with satisfaction in a foreign country¹ has been to prepare two exhibits, one for the larger and a smaller one for the less important fairs. The exhibits are classified, and each class is kept separate from the others so as to constitute an exhibit by itself, and yet all are grouped in the same building and contiguous to each other. The grouping adopted is the following:

(1) *General crop exhibit.*—These contain samples of the principal crops grown in the country.

(2) *Crops recommended.*—These are crops that have been tested by the department and found to be adapted to the country and profitable to cultivate.

(3) *Fertilizers.*—Samples of various fertilizers with the analysis of each and recommendations for their application.

(4) *Implements.*—A collection of such as can be recommended and demonstrations of their use by actual trial, testing their work.

¹ Recommendations for the work of the department in assisting the agricultural work of Bengal Department of Agriculture, Bengal, 1910, No. 2.

(5) *Mycological section*.—These exhibits consist of specimens and plates of the most important diseases of plants systematically arranged, and with labels indicating their character and the methods of preventing their ravages.

(6) *Entomological section*.—This also consists of specimens of all of the important pests and economic insects of the district with samples of insecticides and labels descriptive of each, together with leaflets for distribution giving directions for their control.

(7) *Photographs*.—These illustrate various crops, animals, implements, farm buildings, etc., advisable to imitate or introduce.

(8) *Diagrams*.—These summarize the results obtained by the various methods pursued in crop production, the effect of various manures as shown in the appearance of the crops and their final products, etc.

(9) *Maps*.—These are prepared to show the rainfall in different districts, the variety of soils, the climatic conditions, the crops grown in different sections, etc.

(10) *Leaflets*.—Short, concise statements in leaflet form giving the results obtained with the principal crops under experiment, also results under different rotations and methods of fertilization. Each leaflet treats of some specific crop or subject.

(11) *Plant specimens*.—Small sheaves of the leading varieties of crops selected for their excellence, also specimens of roots, bulbs, flowers, fruits, etc.

(12) *Group labels*.—Sets of labels to be hung over the respective groups, giving a brief description of the group, and lettered so as to be easily read at a distance of 25 or 30 feet.

In charge of this exhibit the department details a corps of men to accompany it throughout the season. This corps consists of a chief agricultural exhibitor, one assistant, an implement exhibitor, one assistant mycologist, one assistant entomologist, and two laborers.

The small exhibit consists of seven groups as follows:

- (1) Crops recommended.
- (2) Fertilizers recommended.
- (3) Implements recommended.
- (4) Entomological plates and specimens.
- (5) Diagrams.
- (6) Leaflets for distribution.
- (7) Group labels.

The force of exhibitors to accompany the small exhibit consists of a chief exhibitor, an assistant exhibitor, an implement exhibitor, and one laborer.

Before entering upon their duties the exhibitors are assembled annually to discuss the work that each is to perform and to agree upon the fundamental facts that are to be presented, so that unity in teaching shall be had and only essential features be treated. In this way the department is informed respecting the character of the work that is performed and also has opportunity to introduce any new features for the betterment of rural conditions that it may deem important.

Each corps of exhibitors is furnished with a diagram showing the method to be followed in arranging the exhibits, and full directions are given for their packing and transportation. A tent 60 by 40 feet is recommended for the display of the exhibits, a small tent 24 by 16 for the use of the exhibitor and his assistants; and a smaller tent 12 by 8

for the workmen. The furniture for the proper display of the exhibit is so constructed as to be readily erected and taken down and packed for transportation.

AGRICULTURAL INSTRUCTION TRAINS.

A special investigation by the farmers' institute office into the extent of the operation of agricultural instruction trains in the United States¹ revealed the fact that 52 of the leading railroad companies had engaged in this form of disseminating agricultural information during the year ended June 30, 1910. The number of cars employed aggregated 239, an average of 4.6 cars per train. The 52 trains traversed altogether during the year 40,771 miles of track and occupied in doing so the equivalent of 589 days for a single train. One thousand seven hundred and ninety-three stops ranging from 40 minutes to 2 days each were made, during which lectures upon agriculture and domestic science topics were delivered, demonstrations made, and exhibits of animals, charts, and agricultural products. Reports received from 26 of the trains that were run showed an attendance of 189,645.

A subsequent investigation for the year ended June 30, 1911, shows that 71 agricultural instruction trains were run that year, in connection with the farmers' institutes, by 28 States, covering 40,305 miles of track, making 2,106 stops and accompanied by 767 skilled lecturers, meeting 995,220 persons.

The method pursued in operating these trains has been for each railroad company to provide at its own expense a locomotive, baggage car, one or two coaches fitted up for lecture purposes, and a Pullman car provided with dining room and sleeping accommodations for the lecture force. The lecturers are usually furnished by the farmers' institute, the agricultural college, or the agricultural experiment station of the State in which the train is run. Not infrequently this corps of teachers is supplemented by specialists from the national and State departments of agriculture.

Each train is supplied with a quantity of illustrative material. If the instruction to be given is along dairy lines, then dairy cattle frequently form a part of the equipment, together with apparatus used in dairy processes. If poultry, swine, field crops, or fruit is the principal feature, then the illustrative material is along these specific lines.

The train is advertised in advance by means of posters and newspaper notices giving the points where it will stop, the hour at which it will arrive at a given station, the length of time it will remain, the names of the lecturers giving instruction, and the topics that

¹ U. S. Dept. Agr., Office Expt. Stas. Circ. 112, Transportation Companies as Factors in Agricultural Extension.

will be discussed. Circulars giving this information are placed in the hands of the local agents of the railroad company with instructions to distribute them throughout the community. In addition to the regular force of railroad employees—engineer, fireman, brakemen, conductor, and caterer—each train is accompanied by a railroad official who is directly in charge of the division of the road over which the train is run.

When the train arrives at a station, the farmers are invited into the lecture coaches and are addressed by the experts in 30 or 40 minute talks. The teaching is accompanied by charts or by printed circulars referring to authorities responsible for the information. Usually this printed matter is made up of statements of the results of experiments conducted by the State experiment stations. Literature also, consisting of bulletins and circulars by other experiment stations and departments of agriculture, is distributed among those who are interested, and information is given as to where additional facts relating to particular subjects can be secured.

The rapid development of this movement as a means of disseminating agricultural information is remarkable and indicates growing appreciation of the importance of agriculture, not simply as a means of support to the population of the country but as a source of revenue to the transportation lines that is capable of almost unlimited expansion and that is perpetual in its supply of profitable freight. No more powerful agency for the development of the agricultural industry has appeared in recent times than the entry of the great railroad organizations into this field. That the movement is capable of untold advantage to the farming industry is apparent from the fact that most of the products of agriculture must be transported to distant markets. If, therefore, sympathetic cooperation between these companies and the agricultural industry can be established and maintained, this transportation will be conducted upon broad business principles that will speedily replace the narrow policy that has too often prevailed in the past which regarded only immediate returns rather than a future income cumulative, perpetual, assured, and abundant.

It is very important at this, the opening stage of this movement, that it should be directed along lines that will lead to the best possible results. Unless this is done, the effort may expend itself before it becomes properly organized and this great influence be withdrawn from active cooperation for the betterment of rural conditions. Serious attention, therefore, should be given to outlining methods that will be effective in producing the results desired and to securing the adoption of these methods by the companies interested in this work.

It would be well worth while to have some one or more men familiar with country conditions and also with the details of management in transportation matters to study the problems involved and endeavor to formulate a plan or set of plans that will be acceptable to the transportation companies which will secure for agricultural people the benefits they need in order properly to market their products and that will also be sufficiently remunerative to the transportation companies to justify them in adopting the methods proposed.

COUNTY AGRICULTURAL EXPERTS.

A serious defect in agricultural institute work, considered as an educational force, is its transient nature and in many instances its complete disappearance from the field of activity for the greater part of the year. During the institute season a force of lecturers comes into a district, comparative strangers to the people and the conditions that exist, deliver addresses, and then leave, never perhaps to appear again in that community. The next year the same or a different corps of institute lecturers come in and go through the same process of lecturing and disappearing, not responsible for getting their teaching into operation in any of the districts they visit.

As advertising agricultural education this system has operated very well, but now that many communities have become informed with respect to the value of science applied to agricultural operations, some more substantial assistance is demanded and more extended instruction by a responsible body of teachers whose advice is tested in the community in which their instruction is given by actual demonstration in the field. There is need now in many localities in all of the States for a man or a corps of men to be located permanently in each county to give attention to the development of its farming interests who will devote their entire time to professional work as advisers and demonstrators along the various lines of agriculture and home economics in which the community is engaged. The valuable results that have attended this form of assistance in the matter of developing and improving agriculture commend it to the attention of the directors of extension work, whether in connection with the farmers' institutes or the agricultural college. The method has been tested abroad until there is no longer a doubt as to its practicability or value.

In a report to the board of agriculture and fisheries and education, London, 1910, the rural education conference of Great Britain, after a very exhaustive study of methods for securing improvement in agricultural operations, recommended the establishment by the county councils of a staff of agricultural experts in each county in

England to supervise agricultural operations and to give advice to farmers of the county respecting the improvement of their crops and the general betterment of their condition. The report outlines the following method for the organization of these staffs:

(1) The minimum staff should be made up as follows:

(a) Agricultural organizer and adviser, who should, as a rule, supervise the agricultural and horticultural work done by the county and act as secretary to the agricultural education committee or subcommittee. He should be in close touch with the head of any center with which the county is associated. He should (so far as his other duties may permit) give some instruction himself, but as a rule he would require competent instructors to assist him.

His main functions would be to get into touch with farmers and other agriculturists, and for this purpose to visit local markets and shows and farmers' clubs, as well as individual farms and small holdings. He should also enlist the sympathy and help of agricultural associations. He would discuss and advise agriculturists on such questions as diseases in crops and animals, manures, cropping, insect pests, etc. He would distribute leaflets or pamphlets relating to rural work (such as those published by the board of agriculture), explain them and possibly make them a basis of discussion. He would organize and supervise illustrative experiments and demonstration plats. He would organize classes for instruction in farm-labor subjects and prize competitions in connection with such subjects as hedging, ditching, thatching, etc.

After becoming thoroughly acquainted with the county, he would advise the committee as to the establishment of permanent centers for agricultural instruction, such as farm institutes, winter schools, etc.

(b) Horticultural instructor, who should give courses of instruction at approved centers, carry out demonstrations on approved horticultural practice, give advice to small holders, allotment holders, cottagers, and others. He should have special charge of the work connected with school gardens and such nature study as may be connected with them. In counties in which horticulture is of special importance it may be desirable that the horticultural instructor should be independent of the agricultural organizer. He should be in touch with any center of horticultural instruction with which the county is associated, and might, by arrangement, give some of the instruction therein.

(c) In most counties a dairying instructor will also be required, who should conduct a fixed or migratory dairy school and give advice when required to farmers and others in dairy practice. In many counties separate instructors would be required to give instruction in the different branches of the dairy industry.

(2) This minimum staff would require to be supplemented by—

(a) Competent scientific investigators and analysts, who would ordinarily be supplied by the center with which the county is associated or from some university or agricultural college.

(b) Instructors in special branches of industry, e. g., farriery and veterinary hygiene, poultry and bee keeping, cider making, hop growing, and such manual processes as hedging, thatching, sheep shearing, etc.

These practical instructors would in most cases be regular members of the staff of the larger or combined counties, but in other cases (e. g., manual processes) local experts might more conveniently be employed as required.

(c) Instructor in forestry, who should be supplied from one of the recognized forestry centers.

(d) Organizers and instructors in the economics of agriculture, e. g., cooperation and credit banks for occupiers of land, the grading and marketing of produce, insurance of stock, etc. These would ordinarily be required to cover larger areas than counties,

and might be supplied through a central body, such as the agricultural organization society, subsidized by the government or by the county councils employing the instructors.

(3) The qualifications of the officials mentioned in the paragraphs above should, as a rule, be as follows:

(1) Agricultural organizer and adviser.

Qualifications.—(a) Thorough acquaintance with the practice of agriculture such as would be obtained by some years' residence on a farm or farms, and active participation in agricultural processes.

(b) A three years' course of agricultural study and laboratory practice at one or more universities or agricultural colleges.

(c) Experience in lecturing and in the conduct of field experiments, with pasture and arable lands.

We recognize that it is at present difficult to get men possessing these qualifications with so long a training, but we believe that the demand will gradually increase the supply.

(2) Horticultural instructor.

Qualifications.—(a) Some years' experience in the practice of horticulture, including fruit growing.

(b) Thorough training in the scientific principles of horticulture such as is obtained at an approved institution.

(c) Experience in lecturing and demonstrating to rural audiences.

(3) Dairying instructor.

Qualifications.—(a) Thorough training in dairy science, with a minimum of a year's special training in dairy practice, at an approved institution.

(b) Practical acquaintance with the processes of milking and of butter and cheese making on a farm or in a factory.

(c) Experience in teaching and demonstrating.

(4) Poultry instructor.

Qualifications.—(a) A thorough training in the theoretical and practical sides of the subject after at least a six months' course at an approved institution.

(b) At least 12 months' practical work on a poultry farm.

(c) Experience in teaching and demonstrating.

(5) Special instructors in veterinary hygiene, farriery, beekeeping, cider making, hop growing, manual processes, etc.

With regard to the other instructors mentioned in the above paragraph, we do not think it necessary to define their qualifications further than that they should be required to produce evidence of a thorough knowledge of their subject, and of capacity to impart instruction.

It must be recognized that these county staffs will not be able to solve all of the problems that arise in their fields of operation. In such cases the difficulties are referred to the State agricultural experiment station or the agricultural college for solution and thus are brought to bear on the question the best expert knowledge and skill that the Nation possesses.

The plan here outlined is being tried in part in the Province of Ontario, Canada, in 26 counties, with most satisfactory results and might well be tested by the directors of farmers' institutes in this country in at least one or two counties in each State in order to demonstrate the workings of the system that it may be witnessed and adopted generally as its value is realized.

Eventually the staffs and conduct of the work might be a part of the organization and duty of the county agricultural societies in cooperation with the agricultural college as their representative head, and national, State, and county appropriations for support of the work might be administered through the colleges which, in turn, would be required to report stately to the national, State, and county authorities respecting the expenditure of the funds and the character of the work performed.

TEACHING BY CORRESPONDENCE.

The attention of farmers' institute and college-extension authorities is now being directed to the need for some method of carrying information to farming people less expensive than the institute meeting and that is also capable of being extended to reach the entire body of rural population instead of the small percentage that has been possible under the existing system, and that will continue the instruction through a period sufficient to enable the student to master the subject.

The correspondence method.—The correspondence method of instruction as originally proposed had as its distinctive feature the reaching of the individual, so that persons unassociated with others could take up the studies prescribed and complete the course. Experience, however, has shown that extended study by isolated individuals is impracticable except in instances too few to be considered in a system that is to include the masses. There is lack of the enthusiasm that comes from association with others in study and of the stimulus that urges the student to complete the course. As a consequence, under the individual study system, a large proportion of those who enter fail to continue. Under this system also there can be very little collateral reading by the student and almost no practicum or laboratory work, both of which are important in any course that is to be at all complete.

Inasmuch as the subject is one of immediate importance to the agricultural interests of the country, a study of what is being done along correspondence lines and of the methods in use has been made by this office and an outline has been prepared designed to correct the defects of the existing system and so to improve the method as to make it educative, easily administered, comparatively inexpensive, of general adaptation, and capable of indefinite extension.

In constructing a method for operating a correspondence course that shall fulfill these conditions eight distinct features were considered:

- (1) A method for the organization of country students into classes.
- (2) The preparation of proper courses of study.

- (3) A method for securing acquaintance on the part of the student with the literature of the subject.
- (4) Provision for laboratory and practice exercises adapted to the teaching and to the capacity of the student.
- (5) Form of periodic reports.
- (6) Method of conducting final examinations.
- (7) Proper administrative features for the system.
- (8) Provision for leadership of the classes.

Formation of classes.—As a result of the investigation, it was concluded first of all that the organization of the students into classes was essential to the effective teaching of agriculture by the correspondence method; second, that the size of the class should ordinarily not exceed a maximum of about 15 persons, or a number that could be instructed in laboratory or practice work by a single teacher; third, that the members of the class should be over 17 years of age, should have completed the equivalent of the eighth grade in the public schools, and have had at least one year's experience in the practical part of the study to be undertaken.

In organizing the class, at least in the early stages of the work, a representative of the institution responsible for the course should visit the community, list the names of those who wish to join the class, assist in securing proper rooms in which the class exercises can be conducted, select the leader, and make out an order upon the college, the experiment station, or the institute for the equipment needed in conducting the course.

Course of study.—The course of study advised is practically that provided by this department for movable schools of agriculture modified to suit correspondence conditions. The principal changes in adapting the courses from movable schools to correspondence work consist in somewhat greater detail of explanation in the body of the printed text; in the addition of a list of queries to follow each lecture; and in a system of reporting to the extension department of the institution responsible for the work. Each lecture also with its corresponding practicum and list of queries is so printed that it may be detached from the bulletin and given to the members of the class as it is studied. This is intended to obviate the necessity for taking notes by the students and at the same time to supply them with references to authorities as well as with specific directions respecting methods and material to be used in their practicum work.

The courses of study are upon a single topic and continue from one week to two months or even longer, according to the requirements of the subject studied. The daily schedule proposed is:

A. M.—Quiz upon the previous lesson.

A. M.—Lecture along new lines during which no notes are taken by the class, but a syllabus of the lecture together with reference to authorities giving more extended information is to be supplied to each member at the close of the lecture.

A. M.—Consulting authorities by the students, reading up references made in the lecture, and familiarizing themselves with the requirements of the "practicum" that is to follow.

P. M.—"Practicum" to consist of laboratory or field exercises in verification of the facts presented in the morning lecture, and for familiarizing the student with analytical methods, by requiring him to actually do the things suggested.

Reading references.—The syllabus furnished to each student indicates the book or pamphlet in which additional information confirmatory of the statements made is given, and also the page or the paragraph where the reference can be found. In order that the references may be consulted a library is supplied by the institution establishing the course containing all the books referred to. When the books or pamphlets are inexpensive, they are to be supplied in duplicate or triplicate according to the requirements of the course so that all of the references in any lecture may be consulted by all of the members of the class during the period for which reference study is prescribed.

Apparatus.—Apparatus for the class is to be furnished by the extension department sufficient to provide each student with a complete set for his individual use during the course. Each member of the class is charged in an itemized account with the apparatus and material committed to him, and a deposit for its value required, the money to be refunded at the close of the course, less 10 per cent and the cost of such material as may have been consumed or broken.

Expenses.—The expense connected with securing a hall, providing janitor services, water, light, heat, seating, desks, and all incidentals is to be met by the locality in which the class is held. Each member is required to pay a registration fee to an amount sufficient to pay the salary of the leader of the class, and to meet such minor incidental expenses as may be necessary.

Examinations.—At the close of each week an examination upon the lectures of the week is to be written up by each student upon blanks provided by the extension department, to be transmitted through the leader of the class to the chief of the extension department for inspection and rating. At the completion of the course an examination upon the entire work will be held, by a representative of the extension department, who will visit the community and conduct the examination.

Certificate.—To all who complete the course and pass the examinations satisfactorily, a certificate of the fact is made out by the institution under whose auspices the course is conducted, and given to the student. This certificate when presented to the agricultural college entitles the holder to credits for entrance to the agricultural course in case he should desire to become a resident student.

Continuation course.—After the completion of the course prescribed, certain of its features may be continued during the year by the stu-

dents at their homes and instruction from time to time be given by the extension department through correspondence. Stated reports of progress and of results obtained are expected from all who undertake the continuation course.

Class demonstration work.—The class should be encouraged also to put into operation in its neighborhood one or more practical demonstrations along the line of the teachings received, and thus exhibit to the citizens of the locality the practical character and advantage of the teaching given. The class also could continue its organization in the form of an agricultural club to meet stately for further study and conference or for merely social purposes, and thus provide in each community an organized body that could be depended upon by the extension department for assistance in the dissemination of literature or for testing the value of such new methods as may be proposed.

Excursions for study.—During the period in which the class is organized for study it is recommended that Saturday excursions be taken to visit places in the neighborhood where important features of the course are being carried out in a practical way.

Public lectures.—An occasional lecture to which the public are invited illustrated by lantern slides showing some of the features that the course embraces will tend to promote interest by the community in the study and may prompt some of the more public-spirited citizens to contribute toward the organization of additional classes for study along the same or different lines.

Annual convention.—A general round-up meeting of all of the students that have been engaged in extension work might be held at the central institution once during the year, at which time they would have opportunity to become acquainted with each other, and be shown the facilities for study that the institution provides.

Independent classes.—Classes in correspondence study could be organized "independently" with little effort and to great advantage, by granges, farm clubs, young people's institute societies, the county farmers' institute, high schools in vacation periods, and by county fair associations.

The leader.—There must be a class leader. In the movable school courses as originally prepared by this office the leader was expected to be an expert thoroughly familiar with the subject taught and able to add to the information given in the printed lessons by drawing from his own resources. He was expected to be able to conduct the reviews and the periodic and final examinations without the aid of a list of questions other than his own. Instruction by such a teacher is, of course, the ideal in agricultural extension. Inability to secure a sufficient number of experts of this character and the expense involved have limited the utilization of the movable school to a comparatively

few of the States—to institutions only whose appropriations have been considerably beyond those of the majority.

Under the method of leadership now proposed, made possible by reason of certain modifications in the courses of study, the class instead of requiring the presence of a thoroughly trained scientist to teach and oversee its work may be led by a layman with perhaps only slight experience in teaching and limited information along scientific lines. He should preferably, however, be a resident of the neighborhood in which the class is organized and should be selected or approved and appointed by the head of the extension department. When appointed he becomes the official representative of that department and is held responsible for all apparatus, books, and material furnished to the class by the institution.

His main business is to see that the work required of the students is performed as outlined in the printed course. He is also in charge of the apparatus and material for laboratory work and has oversight and direction of all of the operations prescribed for performance by the students. He conducts the quiz on the previous day's work, using the printed outline furnished him, assists the students in their reference work, and oversees the practicums. He keeps a record of the attendance, requires weekly examinations, and transmits them together with his report upon the week's work to the chief of the extension department at the central institution.

Practicability of the method.—The practicability of utilizing a lay leader in conducting a class for study in agriculture can only be finally determined by actual trial. The conditions under which the courses are given are, however, such as to make it very probable that fairly good class work can be done under the supervision here proposed. This seems probable from the fact that the text of the courses is by the best experts that the country possesses, the lessons are most carefully arranged, the reference list is very complete, the library is accessible, and time is given for consulting the references, the laboratory exercises are plainly outlined in the text and the apparatus for conducting the several processes is enumerated and supplied. The quiz is guided by suggestive questions; the weekly examinations are forwarded to the central office for inspection and rating to be returned to the student with the corrections marked, and the final examination is held by an expert sent from the institution conducting the course.

The leader undoubtedly should be a man of more than ordinary education, good judgment and practical experience, if possible a graduate of a college of agriculture, or of a normal school, an intelligent, practical farmer of established character and reputation in the community. Any such person should be capable of guiding the work effectively in all of its details except perhaps in the manipulation of

some of the laboratory apparatus although even in this he may be fairly skillful since the use of such material is now quite common in high schools as well as in some of the better class of lower graded schools. The text of the lecture, the outline of the practicum, and the course of reading are all independent of the qualifications of the leader. These, as has been stated, have all been prepared by experts and need only to be presented.

Such difficulties as the leader might experience at the outset in directing the class could be referred to the extension department for solution, and would be overcome as he gained experience and was brought in contact with the various problems that the courses involve. He certainly could render himself competent after he had opportunity to attend the summer school for teachers at the college, and had studied the course with access to all of the apparatus and appliances required, and under the supervision and aid of expert professors at the institution. The range also of any single course is comparatively narrow, and consequently could be mastered fairly well by an intelligent and experienced man by study and the performance of the practice exercises required.

When experience has been gained the leader may find it to his advantage to organize and conduct other classes in his county or elsewhere, and thus continue his work through a considerable portion of the year. If the matriculation fee were made as much as 50 cents per pupil per day the income from a class of 15 persons for 20 days would be \$150, a sum sufficient to pay the salary of the leader and such incidental expenses as might have to be met.

Summer school for class leaders.—A summer school at the agricultural college should be held for the preparation of teachers for extension work in connection with the correspondence courses, and for giving instruction in winter agricultural schools, confining the teaching to the particular line that the student expects to follow and to the laboratory exercises necessary for that school.

If, for instance, an individual wished to become the leader of an extension class in the study of poultry, his work at the summer school would be confined to the outline of study prepared for this course including its laboratory work, class room study and reference reading. He would receive at the completion of his studies a certificate of proficiency in the subject of poultry. In like manner leaders in other lines of education extension would be instructed and certified.

Office force.—The number of high-priced experts required to oversee such a system can be comparatively small, since most of the examination work will be at the headquarters of the extension department, where the papers can be distributed among inexpensive clerks to note their defects and rate them according to their excellence. By limiting each clerk to the examination of certain queries, he will soon become expert in discovering and noting errors in these direc-

tions and accurate in determining the proper grade for each reply. Certain clerks should be required to read up all of the references and perform all of the practice exercises which the queries that they deal with involve until they become thoroughly familiar with every feature of the study. They thus become experts in these points and are competent to inspect and grade most of the answers returned. Where, however, questions arise in the examination papers requiring wider acquaintance with agricultural science and practice than these clerks possess or are able to answer, they can be referred to the head of the extension department and by him to some expert officer either of his own department or of the agricultural college or experiment station for attention. In this way the expense attendant upon the grading of a large number of examination papers can be greatly reduced.

The system self-supporting.—The system also would be self-supporting so far as the actual cost of teaching and the maintenance of equipment are concerned. The expense to the institution would be limited to the salaries and expenses of the director and his office force, together with the initial cost of the libraries of reference and the outfit of apparatus and material needed for practice work. The damage and incidental fees should maintain this equipment unimpaired.

THE WORK OF THE FARMERS' INSTITUTE DIVISION.

The act creating the office of farmers' institute specialist in the Office of Experiment Stations prescribes quite definitely the duties to be undertaken as well as the amount of money that shall be available for carrying on the work. Under this act it is made the duty of the farmers' institute specialist to "investigate and report upon the organization and progress of farmers' institutes in the several States and Territories and upon similar organizations in foreign countries with special suggestions of plans and methods for making such organizations more effective for the dissemination of the results of the work of the Department of Agriculture and the experiment stations, and of improved methods of agricultural practice."

In carrying out these provisions the institute office has collected and published annually information respecting the work of the farmers' institutes in the several States and Territories and the laws under which they are organized. It has also collected and published lists of the lecturers employed by the State directors engaged in farmers' institute work, and has secured and placed on file in the office the personal history of these lecturers together with the topics that they each discuss. These topics are indexed by subjects for convenience of reference when applications are made by State directors for lecturers to supply their programs.

Investigations have been conducted and published respecting similar work conducted in foreign countries and recommendations have been made for improving the methods in use in disseminating agricultural information among farmers as well as plans and suggestions for new work that might be undertaken to advantage.

The office has also carried on investigations into the condition and extent of extension work in the agricultural colleges and experiment stations, and has furnished this information to the Association of American Agricultural Colleges and Experiment Stations for publication in its annual report. Similar investigations have been conducted respecting county fair associations, agricultural instruction trains, young people's institutes, and institutes for women. Courses of study for movable schools of agriculture have been prepared, as well as a series of illustrated lectures upon a variety of agricultural topics. A plan for organizing and conducting study in agriculture by correspondence has been outlined, and a course in conformity with the plan proposed has been published and several others are in course of preparation.

These investigations have broadened the work of the institute division to cover the field of agricultural extension, and together they form bases for future investigations along various lines distinct in their methods of operation but closely related in purpose.

The work of the office therefore as at present outlined consists in a number of distinct divisions:

- (1) The farmers' institute work proper, consisting of:
 - (a) The general or mixed institute.
 - (b) The women's institutes.
 - (c) Institutes for young people.
 - (d) Movable schools of agriculture and domestic science.
 - (e) The organization of farmers' clubs.
 - (f) The establishment of winter schools for adults.
- (2) College extension work, consisting of:
 - (a) Formation of correspondence schools.
 - (b) Formation of local organizations in the various counties to represent the institution locally.
 - (c) The organization of a force of itinerant instructors and advisers.
 - (d) The organization of demonstration work.
- (3) Agricultural fairs—investigations and recommendations:
 - (a) For the improvement of their organization.
 - (b) For rendering their exhibits more directly educational.
 - (c) For securing model plans for grounds and buildings.
 - (d) For the improvement of the entertainment feature of county fairs in order to free them from moral objection.
- (4) Cooperation with State departments of agriculture:
 - (a) By interesting the State departments in the improvement of county fairs.
 - (b) Inaugurating methods for conducting agricultural surveys.
 - (c) Instituting systematic distribution of agricultural literature among farming people.

- (5) Investigations in connection with the transportation companies, particularly with reference to the organization and conducting of agricultural education trains; the use of expert itinerant advisers and demonstration farms.
- (6) Public libraries:
 - (a) To secure a systematic method of supplying agricultural people with literature from the State and county libraries.
- (7) The preparation of agricultural charts for extension teachers.
- (8) The preparation of sets of illustrated lectures for extension workers.
- (9) Conducting investigations into the condition of agricultural education in foreign countries, particularly as respects its extension features.
- (10) The preparation of courses of study for movable and correspondence schools of agriculture and domestic science.
- (11) Cooperation with the Association of American Agricultural Colleges and Experiment Stations in investigations into the extent, character, and most efficient forms of extension activity.
- (12) Cooperation with the American Association of Farmers' Institute Workers in the preparation of programs for the annual meetings of the association, and the editing, publishing, and distributing of the proceedings.
- (13) Collecting illustrative material for a library of illustration in agricultural subjects for use by extension workers.
- (14) Lecturing before farmers' institute assemblies and other educational organizations.
- (15) Conducting the correspondence of the office.

In many of these directions investigations, some preliminary and others quite complete, have been made by the office and the results published, together with recommendations and plans for the improvement of the work in these several lines of extension effort.

There are now needed additional investigations respecting the details of some of these branches of extension activity, and a line of demonstrations in each showing the practicability and value of the plans recommended. Public interest in the work is developing so rapidly that there is danger that wrong methods may be adopted and consequent failures result, to the great injury of the extension movement. If demonstration movable schools, correspondence courses, methods for conducting agricultural fairs, education trains, and similar efforts could be formulated and operated by the department, much useless experimenting in these directions by the States would be avoided and valuable time be gained in securing the adoption of approved forms of activity by the extension workers of the country.

To conduct such demonstrations only men of experience and tested skill should be employed, thereby insuring that the preliminary demonstrations will be under the best possible conditions, and that defects in the systems will immediately be recognized and corrected. By conducting such demonstrations in all of the States those in charge of these respective lines of work would have opportunity to witness the methods pursued and the success achieved, and be prepared to take up the work and conduct it without continued assistance from this department, except in the way of advice and

literature giving information respecting details of operation and items of improvement as better methods are discovered.

During the past year the institute office has had prepared and published bulletins entitled: "Legislation relating to farmers' institutes in the United States;" "A course of study upon the preparation of vegetable foods for movable and correspondence schools;" "The proceedings of the fifteenth annual meeting of the American association of farmers' institute workers;" also three circulars—"Agricultural fair associations and their utilization in agricultural education and improvement," "The transportation companies as factors in agricultural extension," and "List of State directors of farmers' institutes and farmers' institute lecturers of the United States."

There were also published the annual report of the institute specialist on the work of the farmers' institute office, and a translation by the institute assistant in the office of a report upon the Agriculture of Belgium from 1885 to 1910. Three illustrated lectures are now in the hands of the printer, one on Farm Homes; one on Peanut Culture; and another upon Farm Home Grounds—Their Planting and Care.

Cooperation with the committee on extension work of the Association of American Agricultural Colleges and Experiment Stations has been continued. The institute specialist, as secretary of that committee, collected information showing the status and progress of extension work in the land-grant colleges and furnished the data to the committee for its annual report. He has also continued to act as secretary-treasurer of the American Association of Farmers' Institute Workers. As secretary he prepared the program for the annual meeting, secured the speakers, and had a stenographic report made of the proceedings and edited the material for publication. A course of study upon economic entomology has just been completed by the assistant, Dr. Stedman, who has also conducted an investigation into the legal status and work of the State commissioners and secretaries of agriculture of the United States.

The demand for the illustrated lectures prepared in this office has been greater than can be supplied, and a much larger number could be used to advantage. The work of the office could also be made more directly and widely useful if appropriations sufficient to equip it with the requisite force of experts and supply of apparatus could be secured. The institute specialist and his assistant delivered lectures before institute and educational assemblies in various States, and have conducted the correspondence of the office.

STATE REPORTS.

Numerous items of interest in the reports of the State directors are incapable of tabulation or are peculiar to a particular State, and at the same time are important to a complete record and understanding of the progress of the institute work as it develops each year. In order that the great body of institute workers may be familiar with this progress, the principal points are incorporated in the following accounts under the respective names of the States and Territories:

ALABAMA.

Institute director: C. A. Cary, professor of veterinary science, Auburn.

Thirteen hundred dollars was expended during the year for farmers' institutes in the State, which is an increase of over 100 per cent from the previous year. If to this amount we add the services of the director and the members of the college faculty and station staff whose time was contributed by the Alabama Polytechnic Institute to this work, the institutes cost about \$600 more than was actually expended. No local speakers were used, but from two to four State lecturers were sent to each institute, of which there were 28 of the one-day meetings with a total of 48 sessions and an attendance of 3,681. In addition to the above there was a round-up institute, partaking of the nature of a summer school, which lasted 4 days, during which time 24 sessions were held, with a total attendance of 830. The director arranges the places, dates, and programs of the meetings. The boll weevil was a subject for discussion at all the meetings. The State makes an annual appropriation of several thousand dollars to the department of agriculture and industries expressly for farmers' institutes, but the matter is in the hands of the commissioner, who has made no report concerning this work.

ALASKA.

Institute director: C. C. Georgeson, special agent in charge of the agricultural experiment station, Sitka.

No report was received.

ARIZONA.

Institute director: R. W. Clothier, professor of agriculture, Tucson.

An important feature of the farmers' institute work in Arizona is the short courses it holds in the high schools in various portions of the State, thereby reaching the young people as well as the farmers themselves. Two lecturers from the experiment station thus held in four high schools a total of 43 days of these courses, with an attendance of 3,950. There were held in all 51 regular institutes, comprising 95 sessions, with an attendance of 6,779. No State lecturers were employed except the 6 members of the college faculty and station

staff, who devoted an aggregate of 198 days' service to this work. The total cost of all the institute work was \$1,381.24.

ARKANSAS.

Institute director: C. F. Adams, dean and director, Fayetteville.

With \$4,000 from the State and \$1,000 from the college besides the services of 6 persons from the college faculty and station staff, who devoted an aggregate of 200 days' service to the work, there were held 69 regular institutes, comprising 95 sessions, with an attendance of 11,091; and two railroad specials, which covered 704 miles, making 83 stops and meeting 60,000 persons. Cotton, corn, hogs, and domestic science were the subjects discussed. In addition to the above there were also held 17 special institutes at picnics, State meetings of farmers' unions, and local congresses, at which the attendance was 24,210 in the 21 sessions.

CALIFORNIA.

Institute director: W. T. Clarke, professor of horticulture and superintendent of university extension in agriculture, Berkeley.

The State appropriation of \$10,000 and \$750 from the college of agriculture was expended during the year in institute work in 34 out of the 58 counties in the State. There were employed 25 State lecturers, from one to four attending each institute, and in addition there were 190 local speakers. Ten members of the college faculty and station staff contributed an aggregate of 140 days' service. There were held 103 regular institutes, comprising 267 sessions, with 34,038 persons in attendance. One farmers' week, consisting of 40 sessions, was attended by 4,000 people and one picnic with an all-day session had 2,800 listeners. Besides the above one demonstration train consisting of 10 coaches was run 6,281 miles, making 223 stops. It carried 21 lecturers and they spoke to 78,224 people. Lectures by the institute force were also given during the year in teachers' institutes, high schools, normal schools and common schools, comprising a total of 107 days, with audiences aggregating 3,410 persons.

COLORADO.

Institute director: C. H. Hinman, superintendent of agricultural extension, Fort Collins.

Sixty-three State lecturers were employed for institute work during the year. This includes 38 members of the college faculty and station staff, who contributed an aggregate of 787 days' service to this work. A new feature of the institute work was the establishment of co-operative demonstration fields. Three demonstration trains of five cars were run a total of 4,500 miles, making 142 stops. In all, 20 lecturers were used and they addressed 46,627 people. Ten special institutes, comprising 26 sessions with 523 in attendance, were held.

Six institute lecturers addressed 705 people at teachers' institutes. The regular institutes numbered 100 and consisted of 161 sessions, with an attendance of 15,117.

CONNECTICUT.

Institute director: L. H. Healey, secretary State board of agriculture, Hartford.

Twenty-five State lecturers and 10 local speakers held 48 institutes during the year. These consisted of 90 sessions and the attendance was 5,000. There were 10 experts employed as itinerant instructors and demonstrators for a total of 25 days. The cost of the institute work was \$3,000.¹

DELAWARE.

Institute director: Wesley Webb, secretary State board of agriculture, Dover.

Nine hundred dollars was expended during the year for institute purposes. Nineteen State lecturers were employed, of whom 6 were from the college faculty and station staff, who devoted an aggregate of 38 days to the work. There were held in all 24 regular institutes, of which 13 were for men and 11 for women. They consisted of 65 sessions, 36 for men and 29 for women, and the attendance was 8,930, of which number 4,455 were men and 4,475 were women. The institutes for men and those for women are about evenly divided in this State. No other form of institute work was carried on. Institutes were held in every county.

FLORIDA.

Institute director: P. H. Rolfs, director of the agricultural experiment station, Gainesville.

A new feature of the institute work during the year was the holding of two institutes specially for women. These were very successful and were attended by an average audience of 80. Thirty-two young people's institutes were also held in cooperation with the superintendent of public schools of one of the counties. The attendance was 3,000. In addition, there were held 16 special institutes, with 2,000 in attendance. The regular farmers' institutes, of which there were 79, consisted of 158 sessions, with an attendance of 16,980. There were employed 40 local speakers and 14 State speakers, of whom 12 were from the college faculty and station staff, who devoted 218 days to the work. The total cost was about \$7,500.

GEORGIA.

Institute director: A. M. Soule, president State college of agriculture, Athens.

Ten thousand five hundred dollars was expended during the year for institutes. Eighteen lecturers from the college faculty and station staff contributed 158 days to the work and 5 other lecturers were also engaged. The regular institutes numbered 33 and consisted of 96

sessions, with an attendance of 10,960. One railroad instruction train of 7 cars with 15 lecturers covered 5,467 miles, made 154 stops, and was attended by 350,000 people. Special institutes of different kinds were held to the number of 115. They report a total attendance of 22,031. In addition, the institute force gave 108 days' instruction at teachers' institutes, high schools, normal and common schools, at which 14,250 people were in attendance. An expert was employed for 180 days in the capacity of itinerant instructor and field demonstrator.

HAWAII.

Institute director: Wm. Weinrich, secretary and treasurer of the farmers' institutes, Honolulu.

No farmers' institutes were held.

IDAHO.

Institute director: W. H. Olin, superintendent of extension, Boise.

Movable schools were added to the institute work during the year. Seven were for men and consisted of 73 sessions with an attendance of 675, while 3 were for women consisting of 16 sessions with 120 in attendance. There were held 41 regular institutes consisting of 72 sessions with a total of 8,991 persons in attendance. A railroad instruction train of 7 cars with 7 lecturers made 52 stops and reached 8,011 people. Four special institutes were also held at which 850 persons were reported in attendance. One itinerant expert was employed during the entire year. The total cost of the institute was \$2,911.10. Thirty-nine State lecturers were employed, of whom 10 were from the college faculty and station staff.

ILLINOIS.

Institute director: O. D. Center, superintendent of farmers' institutes, Springfield.

The State appropriated \$23,650 for institute purposes and the county board of supervisors appropriated an additional \$5,475, making a total of \$29,650 available for this work during the year and practically all of it was used. A new feature of the institute work was the establishment of movable schools or short courses of a week's duration, 5 of which were conducted for men, 5 for women, and 5 for young people, with an aggregate attendance of 653. The regular institutes numbered 102, composed of 802 sessions with an attendance of 164,731. A portion of each institute was devoted to the women and to the young people. In addition, 4 special institutes consisting of 36 sessions were also held, with an attendance reported at 11,500. Three railroad instruction trains composed of from 2 to 4 cars each with from 4 to 6 lecturers were run for a total of 15 days, making 8 stops each day and reaching 60,000 people. Institutes were held in every county in the State.

INDIANA.

Institute director: W. C. Latta, farmers' institute specialist, La Fayette.

With an appropriation from the State for institute purposes of \$10,000 supplemented by county appropriations and large private donations, the sum of \$17,650 was expended during the year for this work. Fifty State lecturers were employed, which included 11 from the college faculty and station staff who devoted a total of 39 days to the institutes. As the farmers' institute work in this State was carried on as a part of the extension work of Purdue University, several forms of the work usually grouped under institute work are not here included. There were held during the year 382 regular institutes. These consisted of 1,267 sessions and were attended by 201,580 people. A normal institute and conference of workers intended primarily for speakers and officers of local institute associations held 11 sessions and was attended by 635 persons. Institutes were held in every county in the State.

IOWA.

Institute director: A. R. Corey, secretary of agriculture, Des Moines.

Institutes were held in 76 out of the 99 counties in the State and consisted of one institute per county, aggregating 670 sessions with 137,703 in attendance. The total cost was reported as \$17,747.27.

KANSAS.

Institute director: J. H. Miller, superintendent of extension work, Manhattan.

County institutes are organized in 102 of the 105 counties in this State and an institute was held in one other. They are planning to organize in every institute a woman's auxiliary with a definite membership, officers, and program. In all, there were held 300 regular institutes consisting of 808 sessions with an attendance of 58,504. There were held during the year 7 movable schools for men consisting of 21 sessions with 180 registered in attendance, and 16 movable schools for women consisting of 96 sessions in which 463 members were registered. Addresses by the institute force were given to 236 special meetings with an attendance of 52,000. Two railroad instruction trains composed of two cars were run 2,500 miles, making 145 stops. Ten lecturers spoke at these meetings which were attended by 8,670 persons. The subjects of dairying and pork production were discussed. Thirty-six State lecturers were employed, of whom 31 were from the college faculty and the station staff, who contributed in all 757 days to the work, and there were, besides these, over 2,000 local speakers. Seventeen institute lecturers also made talks at teachers' institutes, high schools, normal schools, and common schools, devoting in all 315 days' service and speaking to 31,000 people.

Eleven persons were employed the entire year in various forms of extension teaching, for which the State gave \$27,500, of which amount about \$15,000 was expended for the farmers' institute phase of the work.

KENTUCKY.

Institute director: M. C. Rankin, commissioner of agriculture, Frankfort.

At least one institute was held in every county of the State, and in 70 counties boys' corn-growing contests were organized. The Department of Agriculture furnished the seeds and gave a diploma of honor to every boy growing 60 or more bushels to the acre. The cost of the institute for the year was \$9,000. There were 17 State lecturers, only 4 of whom were from the college faculty and station staff, but they devoted 30 days each to the work, or 120 days in all. There were held 70 boys' meetings of one session each with a total of 8,750 in attendance and 3 institutes for women with one session each at which there were 540 present. The regular institutes numbered 139, consisting of 695 sessions with an attendance of 69,500. One railroad instruction train of 3 cars was run 352 miles and made 17 stops. Seven lecturers spoke on corn, alfalfa, clover, cowpeas, and dairying at these meetings, which were attended by 5,100 people.

LOUISIANA.

Institute director: E. O. Bruner, commissioner of agriculture, Baton Rouge.

Every farmers' institute carried on during the year was financed entirely by the college of agriculture and the experiment station and the work was directed by the dean and director, W. R. Dodson. All of the lecturers were from the college faculty and station staff, 12 of whom participated. Thirty-two regular institutes were held, consisting of 60 sessions with an attendance of 4,800. One movable school was conducted at which 3 days were devoted to men, 1 day to women, and 3 days to young people, the total registration being 148 persons. Nineteen lecturers also addressed 73,500 people who attended the 3 railroad instruction trains, which carried a total of 17 cars, ran 1,550 miles, and made 84 stops.

MAINE.

Institute director: J. P. Buckley, commissioner of agriculture, Augusta.

Two institutes were held in every county in the State at a cost of about \$3,000. Sixteen State lecturers were employed, of whom 4 were from the college faculty and station staff, who spent 13 days in the work. Local speakers also addressed the meetings. There were 44 regular institutes, consisting of 89 sessions, and 9,868 people attended them. Institute lecturers spoke also at various agricultural associations and meetings to the number of 24, the attendance

at which was 2,126. One railroad instruction train with 7 cars made 30 stops in going 621 miles and was attended by 8,000 people. A larger amount of demonstration work was introduced than formerly.

MARYLAND.

Institute director: R. S. Hill, director of the farmers' institutes, Upper Marlboro.

At a cost of \$4,725, 20 State lecturers were employed for institute work during the year. These included 7 of the college faculty and station staff, who contributed 28 days' service to the work. Fifty-three regular institutes for men, composed of 118 sessions with an attendance of 13,960 and 2 institutes for women were held. There were also 3 independent institutes with 1,000 in attendance and 3 railroad instruction trains of 5 cars, which made 26 stops. The 5 lecturers to each train addressed in all 1,283 people.

MASSACHUSETTS.

Institute director: J. L. Ellsworth, secretary State board of agriculture, Boston.

With an expenditure of \$2,421.30, institutes were held during the year in every county in the State, the total number of institutes being 140, composed of 198 sessions, and with an attendance of 21,812. A railroad instruction train of 4 cars covered 150 miles, during which it made 18 stops and was attended by 6,000 people.

MICHIGAN.

Institute director: L. R. Taft, superintendent of farmers' institutes, East Lansing.

Institutes were held in all the counties of the lower peninsula and in most of those of the upper. Fifty State lecturers were employed, of which 8 were from the college faculty and station staff, and in addition about 1,000 local speakers addressed the meetings. Five of the college and station staffs devoted a total of 75 days to institutes in connection with the 3 railroad specials, which carried 7 cars, made 90 stops in going 3,300 miles, and reached 18,801 persons. Regular institutes for men numbered 444 and consisted of 1,202 sessions, with an attendance of 136,521, while the regular institutes for women numbered 47 and about 4,912 attended. A large number of special institutes were also held. The total expense for the year was \$8,500.

MINNESOTA.

Institute director: A. D. Wilson, superintendent of farmers' institutes, St. Paul.

Twenty thousand eight hundred and eighty dollars and ninety cents was expended during the year in carrying on institute work, which covered every agricultural county in the State. A special staff of 18 lecturers was engaged for the work, and therefore the services of no members of the college faculty or station staff were needed. The

regular institutes numbered 218 and consisted of 602 sessions, with an attendance of 114,746. Seven railroad instruction trains, carrying from 4 to 7 cars each, were run about 4,000 miles and made 196 stops, reaching 23,315 people. The holding of farm-crop exhibits in connection with the institute was encouraged. The request was quite generally responded to, and great interest was manifested in the exhibits.

MISSISSIPPI.

Institute director: W. L. Hutchinson, director of farmers' institutes, Agricultural College.

Institutes were held in every county in the State. There were 205 regular institutes, with a total of 347 sessions and an attendance of 46,830. Nine sessions of a round-up institute were held, at which the attendance was 1,800. The institutes cooperated with the boys' corn clubs and the girls' domestic science clubs, which reached some 15,000 members. The total cost was \$10,000.

MISSOURI.

Institute director: T. C. Wilson, secretary State board of agriculture, Columbia.

Twenty-one State lecturers were employed in institute work during the year, of which 15 were from the college faculty and station staff. The regular institutes numbered 170 and consisted of 384 sessions, at which a total of 64,077 were in attendance. Six lecturers also accompanied 4 railroad instruction trains of from 4 to 6 cars each. These covered 2,777 miles of track, during which 112 stops were made. The total attendance was fully 100,000. The cost of the institute work was about \$7,500.

MONTANA.

Institute director: F. S. Cooley, superintendent of Montana farmers' institutes, Bozeman.

Institutes were held in each county in the State. Fourteen State lecturers were engaged in the work, 7 of whom were from the college faculty and station staff, and they devoted in all 228 days to this work. The total cost of all institute work was \$10,000. There were 85 regular institutes held, with a total of 147 sessions and 11,973 in attendance, besides 22 sessions of special institutes, with 5,200 people present. The institute lecturers also devoted 91 days to addressing 4,000 people in the high schools. A railroad instruction train of 9 cars, covering 1,800 miles, made 37 stops, carried 19 lecturers, and was attended by 28,900 people.

NEBRASKA.

Institute director: C. W. Pugsley, superintendent of farmers' institutes, Lincoln.

The institutes for the year had at their disposal \$15,484.80. Twenty-one lecturers were employed, of whom 14 were from the

college faculty and station staff. They devoted a total of 49 days to the work. Six institute lecturers gave in all 146 days to movable school work not included in the report of the institute proper. Five movable schools belonging to the institute work proper, lasting 6 days each, were held for men, with an attendance of 566; and 5, lasting 6 days each, were held for women and had 593 registered in attendance; while 2 such schools, lasting 2 days each, were given to young people and registered 244 in attendance. The regular institutes for men numbered 116 and consisted of 264 sessions, with a total attendance of 54,783. Regular institutes for young people numbered 32, with 37 sessions, and 8,487 attended. A number of special institutes were also held, which were attended by 1,200 people; besides a railroad instruction train of 4 coaches to exploit pork production was run 245 miles, made 32 stops, carried 7 lecturers, and reached 6,293 people.

NEVADA.

Institute director: J. E. Stubbs, president of the Nevada State University, Reno.
No institutes were held.

NEW HAMPSHIRE.

Institute director: N. J. Bachelder, secretary State board of agriculture, Concord.
Eight State lecturers were employed during the year, 5 of whom were college and station men, who devoted a total of 14 days to the work. The cost of the institutes was \$1,000. There were 13 of them, aggregating 30 sessions, and the attendance was 6,800.

NEW JERSEY.

Institute director: Franklin Dye, secretary State board of agriculture, Trenton.
Regular institutes were held to the number of 47, which were made up of 141 sessions and were attended by 8,195 people. The round-up institute continued for 5 sessions and had 1,200 persons in attendance. The institute also cooperated with the farmers' week at the State college farm in the winter and at the field day during the summer, in both of which the total attendance was 1,100. Five railroad instruction trains, of 4 cars each, carried 8 lecturers, made 25 stops, and reached 2,575 people. All lecturers were employees of the State, mostly from the faculty of the agricultural college.

NEW MEXICO.

Institute director: W. E. Garrison, president of the State college of agriculture, Agricultural College.

No regular institutes were held but some members of the college faculty and station staff lectured at a few meetings of farmers.

NEW YORK.

Institute director: R. A. Pearson, commissioner of agriculture, Albany.

A very successful new feature was inaugurated this year, called "follow up" work, as follows:

At the regular institutes a list is made of those persons desiring advice on definite agricultural problems and after the close of the institute season the four institute conductors personally visit a large number of these persons and give advice on such problems as soil fertility, drainage, planting orchards, raising alfalfa, etc. About 50 days were devoted to this itinerant work and some 75 different farms were visited. Institutes were held in all the counties of the State except five, which were either in the Adirondack Mountains or near New York City where no agricultural interests exist. There were held during the year 340 regular institutes composing a total of 1,201 sessions and attended by 128,131 persons. In addition, there were conducted 7 different movable or institute schools, each lasting 3 or more days, and embracing in all 63 sessions with a total attendance of 15,805. These schools gave a higher degree of instruction than is possible in the regular institutes. There were also held 24 special institutes consisting of 50 sessions with 3,344 people in attendance. Institute lecturers also gave instruction in schools in 146 towns aggregating 203 sessions and attended by 30,454 people. The State employed 111 lecturers, only a few of whom were from the college of agriculture or the 2 experiment stations. The cost of the work for the year was about \$28,500.

NORTH CAROLINA.

Institute director: T. D. Parker, director farmers' institutes, Raleigh.

Institutes were held in all but 2 counties in the State. There were held 198 regular institutes for men consisting of 429 sessions with 27,670 in attendance and 174 institutes for women consisting of 346 sessions with 22,319 in attendance. In addition there were 21 special institutes with a total attendance of 3,638. Twenty-nine State lecturers were employed, which included 5 from the college faculty and station staff, who gave in all 125 days' service to the work. The total cost of the institutes was \$7,350.

NORTH DAKOTA.

Institute director: T. A. Hoverstad, superintendent of farmers' institutes, Fargo.

Institutes specially for women were inaugurated during the year and were a great success. The 5 which were composed of a total of 11 sessions being attended by 3,750 people. The regular institutes for men numbered 82 and included 226 sessions with an attendance of 37,567. In addition, there were 19 special institutes consisting of 40

sessions which were attended by 13,850 people, and 2 movable schools were also carried on. There were 23 State lecturers, of whom 10 were from the college faculty and station staff who contributed in all 60 days to the work. The cost of the institutes was \$9,493.24.

OHIO.

Institute director: A. P. Sandles, secretary State board of agriculture, Columbus.

Institutes were held in every county in the State. There were 30 State lecturers employed and a number of local speakers, but no members of the college faculty or station staffs lectured at these meetings. The cost of the institute work was \$22,000, which enabled the holding of 323 regular institutes consisting of 1,615 sessions with an attendance of 376,185. There were also 120 sessions of special institutes with 27,600 in attendance and a railroad instruction train of 5 cars which made 27 stops, covering 485 miles. Sixteen lecturers gave instruction and 10,145 people were reached.

OKLAHOMA.

Institute director: E. P. Ansley, superintendent of county farmers' institutes, Oklahoma City.

Every county in the State held institutes during the year. The cost of the work was \$5,000. Seven State lecturers were employed and 25 local speakers. At the time the report was received the regular institutes were incomplete. About 129 had been held for men at which 5,320 were present and 10 had been held for women. There were also 15 movable schools for men, the same for women, and a like number for young people, and 4 railroad instruction trains of 7 coaches each, carrying 10 lecturers. In addition, there were held 10 special institutes at which 5,000 people were in attendance.

OREGON.

Institute director: J. Withycombe, director of agricultural experiment station, Corvallis.

A new feature of the institute work in this State was the holding of 10 movable schools which proved to be very popular and created much interest. They were attended by 3,350 people. The 33 regular institutes consisted of 66 sessions and had an attendance of 18,520. Of the 10 State lecturers, 6 from the college faculty and station staff devoted 100 days to the work. The total cost was \$2,500.

PENNSYLVANIA.

Institute director: A. L. Martin, deputy secretary of agriculture, Harrisburg.

The sum of \$22,500 was expended during the year for institute purposes. Seventy-five State lecturers were employed which included

15 from the college faculty and station staff who devoted in all 111 days to the work. There were held 221 regular institutes consisting of 980 sessions, and the attendance was 162,809. Movable schools were held in 15 places for a total of 58 days with a registration of 16,198. There were also 36 special institutes consisting of 80 sessions, at which 30,376 persons were in attendance. The institute lecturers also addressed 29 teachers' institutes and schools and 5 experts acted as itinerant instructors and demonstrators for a total of 10 days.

PORTO RICO.

Institute director: D. W. May, special agent in charge of the agricultural experiment station, Mayaguez.

No report was received.

RHODE ISLAND.

Institute director: J. D. Dunn, secretary of the State board of agriculture, Providence.

With an expenditure of \$430.18 there were employed 32 State lecturers, 6 of whom were from the college faculty and station staff who devoted a total of 12 days to the work, and 3 experts were kept in the field a total of 150 days acting as itinerant advisers and demonstrators. There were held 23 regular institutes aggregating 28 sessions with 2,640 in attendance and 23 special institutes with 2,640 in attendance.

SOUTH CAROLINA.

Institute director: T. C. Haddon, acting superintendent of farmers' institutes, Clemson College.

Institutes were held during the year in every county in the State, 14 State lecturers being employed for the purpose, 6 of whom were from the college faculty and station staff and who contributed 14 days each to the work. The total cost of the institutes was \$11,197.27. Two itinerant experts were employed during the entire year in giving advice and demonstrations to individual farmers. One railroad instruction train of 7 cars covered 1,000 miles, making 22 whole day stops, and instructed 2,200 people. The regular institutes numbered 76 which comprised 152 sessions, with an attendance of 27,000 besides a special institute of 9 sessions, which had 1,000 in attendance.

SOUTH DAKOTA.

Institute director: H. H. Stoner, superintendent of farmers' institutes, Highmore.

The institute organization is cooperating with the rural schools in conducting boys' corn contests and corn schools. The demand for this work is growing rapidly and is developing so as to include the girls in domestic-science work. All but 6 counties in the State held

institutes, and the cost was \$10,469.76. There were 414 sessions of regular institutes, distributed among 116 institutes, and the attendance was 13,100. Aid was also given to a dry-farming meeting, 2 State development meetings, and a good-roads meeting, in all of which 26,400 people were present.

TENNESSEE.

Institute director: T. F. Peck, commissioner of agriculture, Nashville.

There were held during the year 42 regular institutes of 2 sessions each, the attendance at which was 4,142, and 5 movable schools, each lasting 5 days, at which a total of 150 were registered. There were also 48 sessions of special institutes, with 6,700 in attendance. A railroad instruction train of 2 cars was run over about 140 miles of track, made 15 stops, was accompanied by 6 lecturers, who spoke to 2,000 people on live stock and agriculture. The college and station furnished 8 of the 20 lecturers, and they devoted 42 days in all to the work. The cost was \$4,500.

TEXAS.

Institute director: J. W. Neill, director of farmers' institutes, Austin.

A special round-up institute of 3 sessions was held at which 1,500 were in attendance, and a Texas State farmers' institute was organized. There were held during the year 292 regular institutes, aggregating 498 sessions, attended by 23,360 people. A "Texas larger-crop" railroad special institute train of 8 cars made 16 stops in going 150 miles and reached 7,650 persons. Twenty days were devoted to institute work by 4 members of the college faculty and station staff, and 8 other lecturers were employed. The total cost was \$5,000.

UTAH.

Institute director: L. A. Merrill, director of the agricultural college extension work, Salt Lake City.

Seven out of the 10 State lecturers were members of the college faculty and station staff. Two itinerant experts were employed the entire year in giving demonstrations and advice to individual farmers. Four institutes for women were attended by 278 persons, and 57 sessions for men, comprising 45 institutes, had 5,667 listeners. Assistance was given a dry-farming meeting, at which 1,500 were present, and 3 railroad instruction trains of from 4 to 7 cars were run. Each made 113 stops, attended by 41,258 persons. The total cost was \$5,000.

VERMONT.

Institute director: O. L. Martin, commissioner of agriculture, Plainfield.

One railroad instruction train of 5 cars covered 183 miles, made 24 stops, carried 15 lecturers, and instructed 7,000 people. A farmers'

week of 40 sessions had 425 listeners and a forestry field meeting had 175 in attendance. The 50 regular institutes consisted of 83 sessions and had 7,660 persons in attendance. Five members of the college faculty and station staff devoted in all 16 days to institute work, and 7 others were employed. In all, the cost was \$3,000.

VIRGINIA.

Institute director: J. J. Owen, director of farmers' institutes, Richmond.

There were conducted during the year 55 regular institutes, each composed of 2 sessions, with a total attendance of 6,000. A feature of the institute work was the conducting of railroad instruction trains. There were 7 of these trains of 4 cars each, and they covered in all 1,800 miles, during which they made 140 stops. There were 3 lecturers on each train, and the attendance averaged about 75 at each place. The movable-school phase of the institute work was under the control of the Virginia College of Agriculture and Polytechnic Institute. Eight of their staff conducted 16 of these movable schools, each lasting 3 days, and having in all a registered attendance of 6,500. About \$15,000 was available for institute work during the year.

WASHINGTON.

Institute director: Robert C. Ashby, superintendent of farmers' institutes, Pullman.

An itinerant expert was employed nearly a year in giving demonstrations and in personally advising individual farmers. Seven thousand dollars was expended in institute work, most of which was done by the college faculty and station staff, 9 of whom together contributed 250 days to the work. Only one other State lecturer was employed and only 3 local speakers addressed audiences. There were held 34 regular institutes, consisting of 102 sessions, with 5,578 persons in attendance and 33 special institutes with 4,700 in attendance. A special feature of the work was the conducting of 7 railroad instruction trains, each composed of 9 cars. These trains carried from 5 to 9 lecturers, covered 2,300 miles, making 153 stops, and reached 42,658 people.

WEST VIRGINIA.

Institute director: J. M. Millan, secretary State board of agriculture, Charleston.

The movable-school phase of the institute work, as well as most of the railroad instruction-train work, was conducted by the college of agriculture and hence was not reported as an institute in this State's activity. There were employed 24 State lecturers, none of whom were from the college or station. There were 88 regular institutes held, consisting of 401 sessions, with a total attendance of 26,100. There were 2 railroad instruction trains of 3 cars each, with 6 lecturers, who addressed in all 2,010 people in the 10 places at which stops were made. The total cost was reported as \$8,000.

WISCONSIN.

Institute director: G. McKerrow, director of farmers' institutes, Madison.

Thirty-nine State lecturers were employed in institute work during the year, which, together with the printing of the annual bulletin and the cook book, cost \$20,000. Regular institutes for men were held at 137 places, composed of 668 sessions, at which 106,166 people attended. Forty-one institutes for women, aggregating 83 sessions, were attended by 7,500 persons.

WYOMING.

Institute director: H. G. Knight, director of the agricultural experiment station, Laramie.

All the institutes were conducted by the college faculty and station staff, who, for an expenditure of about \$250, succeeded in holding 2 institutes for a total of 10 sessions, and instructed 676 people.

STATISTICS OF FARMERS' INSTITUTES.

Number of institutes held and the approximate attendance during the year ended June 30, 1911.

State or Territory.	Number of one-day meetings.	Number of three or more day meetings.	Total number of institutes.	Total number of institutes held during the year.	General institutes.	Women's institutes.	Young people's institutes.	Youn <i>g</i> people's institutes.	General institutes.	Women's institutes.	Young people's institutes.	Youn <i>g</i> people's institutes.	General institutes.	Women's institutes.	Young people's institutes.	Youn <i>g</i> people's institutes.	General institutes.	Women's institutes.	Young people's institutes.	Youn <i>g</i> people's institutes.	General institutes.	Women's institutes.	Young people's institutes.	Youn <i>g</i> people's institutes.	Total attendance at all sessions.	Total attendance at all sessions.	Aver-age per ses-sion.				
Alabama.....	28																														
Alaska ¹																															
Arizona.....	51																														
Arkansas.....	65																														
California.....	87																														
Colorado.....	89																														
Connecticut.....	45																														
Delaware.....	12	10																													
Florida.....	74	2	32																												
Georgia.....	30		34																												
Hawaii.....																															
Idaho.....	14																														
Illinois.....																															
Indiana.....	217																														
Iowa.....																															
Kansas.....	197																														
Kentucky.....	20		3	70																											
Louisiana.....																															
Maine.....	44																														
Maryland.....																															
Massachusetts.....	139	1																													
Michigan.....	366	46																													
Minnesota.....	134																														
Mississippi.....	205																														
Missouri.....	127																														
Montana.....	80	4																													
Nebraska.....	114		27																												
Nevada ¹																															
New Hampshire.....	12																														
New Jersey.....																															

77

71

117

128

94

55

137

104

3,000

8,750

80

125

205

160

205

72

102

80

80

118

110

400

4,912

133

190

135

164

81

8487

8,487

210

226

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New Mexico ²	242	166	1,679	48	196	7	11	5,400	312	177	7,472	374	199	16,001	577	163	2,218,158	47,962	25,737	138	
New York.....	242	173	1	1	1	1	1	198	174	201	175	226	349	429	346	128,131	22,319	64	106		
North Carolina.....	196	5	14	2	2	2	2	82	5	100	5	11	37	670	367	22,567	3,750	174	64		
North Dakota.....	66	5	323	30	2	10	3	323	10	129	3	3	376,185	376,185	376,185	376,185	376,185	376,185	233		
Ohio.....	79	10	3	5	2	3	2	33	33	209	10	42	3,320	3,320	3,320	3,320	3,320	3,320	280		
Oklahoma.....	26	194	194	1	1	1	1	221	221	415	415	980	18,520	18,520	18,520	18,520	18,520	18,520	166		
Oregon.....	27	22	22	1	1	1	1	23	23	24	24	28	152	4	2,640	2,640	2,640	2,640	94		
Pennsylvania.....	74	66	66	2	1	6	6	76	2	104	6	6	182	4	2,990	2,990	2,990	2,990	173		
Porto Rico ¹	32	30	30	1	1	5	5	6	6	42	42	42	365	25	24	4,600	3,000	3,000	3,000		
Rhode Island.....	42	43	43	2	2	2	2	292	292	45	45	47	498	84	4,142	4,142	4,142	4,142	49		
South Carolina.....	257	50	50	8	8	5	5	50	50	50	50	50	57	4	23,360	23,360	23,360	23,360	47		
South Dakota.....	43	55	55	136	136	40	40	55	55	55	55	55	83	5,667	5,667	5,667	5,667	5,667	5,667		
Tennessee.....	26	13	13	75	75	1	1	88	88	137	137	41	163	163	7,660	7,660	7,660	7,660	92		
Texas.....	13	1	1	1	1	1	1	2	2	2	2	5	275	83	401	401	401	401	54		
Utah.....	1	1	1	1	1	1	1	1	1	1	1	10	668	83	106,166	106,166	106,166	106,166	55		
Vermont.....	1	1	1	1	1	1	1	1	1	1	1	10	676	676	7,500	7,500	7,500	7,500	65		
Virginia.....	1	1	1	1	1	1	1	1	1	1	1	1	10	10	10	10	10	10	68		
Washington.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
West Virginia.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Wisconsin.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Wyoming.....	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		
Total.....	3,525	257	166	1,679	48	196	7	11	5,400	312	177	7,472	374	199	16,001	577	163	2,218,158	47,962	25,737	138

¹ No institute held. ² No regular institutes. Speakers were sent to six meetings of farmers held under local initiative.

Financial statistics of the farmers' institutes for the year ended June 30, 1911.

State or Territory.	Funds appropriated.		Cost of institutes.		Appropriation for the season 1912.
	By the State.	By the college and received from other sources.	Total cost.	Cost per session.	
Alabama.....	\$600.00	\$700.00	\$1,300.00	\$27.08	\$1,300.00
Alaska ¹					
Arizona.....	1,381.24		1,381.24	14.55	1,500.00
Arkansas.....	4,000.00	1,000.00	5,000.00	50.50	5,000.00
California.....	10,000.00	750.00	10,750.00	40.25	15,000.00
Colorado.....	5,000.00	239.00	5,239.00	32.53	5,000.00
Connecticut.....	5,000.00		5,000.00	55.55	
Delaware.....	900.00	150.00	1,050.00	16.15	1,000.00
Florida.....	7,500.00		7,500.00	38.02	7,500.00
Georgia.....	2,500.00	8,000.00	10,500.00	109.37	2,500.00
Hawaii ¹					
Idaho.....	2,911.10	1,200.00	4,111.10	57.09	2,500.00
Illinois.....	23,650.00	5,475.00	29,125.00	36.06	29,650.00
Indiana.....	10,000.00	9,750.00	17,650.00	13.90	
Iowa.....	5,582.23	12,794.65	17,747.27	26.49	7,500.00
Kansas.....	15,000.00		15,000.00	18.50	23,000.00
Kentucky.....	15,000.00		9,000.00	11.70	15,000.00
Louisiana.....		1,100.00	1,100.00	18.22	
Maine.....	3,000.00		3,000.00	33.68	3,000.00
Maryland.....	6,000.00		4,725.00	40.00	6,000.00
Massachusetts.....	4,000.00		2,421.30	12.23	5,000.00
Michigan.....	8,500.00		8,500.00	6.80	8,500.00
Minnesota.....	18,000.00	2,985.00	20,880.90	34.68	23,000.00
Mississippi.....	7,500.00	2,500.00	10,000.00	28.81	7,500.00
Missouri.....	15,000.00		15,000.00		
Montana.....	10,000.00		10,000.00	68.00	10,000.00
Nebraska.....	10,000.00	5,484.80	15,484.80		17,500.00
Nevada ¹					
New Hampshire.....	1,200.00		1,500.00	50.00	1,200.00
New Jersey.....		3,000.00	3,000.00	21.30	
New Mexico ⁴					
New York.....	25,000.00	3,500.00	28,500.00	23.75	35,000.00
North Carolina.....	7,500.00		7,350.00	9.47	7,750.00
North Dakota.....	6,000.00	3,493.24	9,493.24	40.05	6,000.00
Ohio.....	22,000.00		22,000.00	13.62	26,400.00
Oklahoma.....	5,000.00		5,000.00		10,500.00
Oregon.....	2,500.00	500.00	3,000.00	45.45	2,500.00
Pennsylvania.....	25,500.00		25,500.00	26.02	25,500.00
Porto Rico ¹					
Rhode Island.....	430.18		430.18	15.36	
South Carolina.....	10,243.42	953.85	11,197.27	71.77	15,700.00
South Dakota.....	9,475.05	5 991.71	10,469.76	25.28	13,000.00
Tennessee.....	5,000.00		4,500.00	53.57	5,000.00
Texas.....	5,000.00		5,000.00	12.04	
Utah.....	6,000.00		6,000.00	100.00	10,000.00
Vermont.....	3,000.00	750.00	3,750.00	45.18	3,000.00
Virginia.....	5,000.00		5,000.00	45.45	5,000.00
Washington.....	8,500.00		7,000.00	68.62	10,000.00
West Virginia.....	8,000.00		8,000.00	20.00	
Wisconsin.....	20,000.00		20,000.00	26.63	20,000.00
Wyoming.....	1,000.00		250.00	25.00	
Total.....	367,376.22	65,317.25	418,406.06	25.00	423,000.00

¹ No institute held.² For institute and extension work combined.³ Director's salary not included.⁴ No report.⁵ Overdraft.

Number of lecturers employed by the State directors of farmers' institutes and reports of proceedings published for the year ended June 30, 1911.

State or Territory.	Total number of lecturers on the State force.	Number of members of agricultural college and experiment station staffs engaged in institute work.	Number of days contributed to institute work by agricultural college and experiment station lecturers.	Number of State lecturers giving agricultural instruction at—				Reports of proceedings.	
				Teachers' institutes.	High schools.	Normal schools.	Common schools.	Published.	Number of copies.
Alabama	13							No.	
Alaska ¹								No.	
Arizona	7	6	198		2			No.	
Arkansas	10	6	200					No.	
California	30	10	140	3	2	1	2	Yes.	12,500
Colorado	28	38	787	6				No.	
Connecticut	40							No.	
Delaware	11	6	38					Yes.	
Florida	22	12	218					Yes.	20,000
Georgia	23	18	158		8	11	2	Yes.	2,000
Hawaii ¹								No.	
Idaho	38	10		3	1	1		No.	
Illinois	105		279					Yes.	50,000
Indiana	49	11	39					No.	
Iowa	32							No.	
Kansas	34	31	757	4	12	1		No.	
Kentucky	21	4	120					No.	
Louisiana	10	12		3			3	No.	
Maine	21	4	13					Yes.	4,000
Maryland	22	7	28					No.	
Massachusetts	45	14	12					No.	
Michigan	50	8	36					Yes.	12,500
Minnesota	24							Yes.	50,000
Mississippi	15	7	50					No.	
Missouri	24	15						No.	
Montana	18	7	228		14			No.	
Nebraska	24	14	49					Yes.	3,000
Nevada	13							No.	
New Hampshire	20	5	14					Yes.	1,500
New Jersey	10							No.	
New Mexico ²								No.	
New York	53							Yes.	9,000
North Carolina	28	5	125					Yes.	35,000
North Dakota	14	10	60		1			Yes.	15,000
Ohio	31							Yes.	10,000
Oklahoma	13							No.	
Oregon	13	6	100					No.	
Pennsylvania	71	15	111	3	6		20	Yes.	5,000
Porto Rico ¹								No.	
Rhode Island	26	6	12					Yes.	1,500
South Carolina	15	6	84	3				No.	
South Dakota	13	4	15	1				No.	
Tennessee	14	8	42					Yes.	5,000
Texas	6	4	20					No.	
Utah	16	7						Yes.	10,000
Vermont	5	5	16					Yes.	10,000
Virginia	8	8	45					No.	
Washington	18	9	250					No.	
West Virginia	23			5		1		No.	
Wisconsin	23							Yes.	50,000
Wyoming	7	7	15					Yes.	500
Total	31,156	345	4,259	39	49	9	29		306,500

¹ No institute held.² No report.³ Deducting duplications the total number is 1,120.

Special institutes, including movable schools, railroad specials, independent and round-up institutes, picnics, fairs, conventions, and field-demonstration meetings for the year ended June 30, 1911.

	15	58	16,198						24	60	10,376						12	20	20,000		46,574
Pennsylvania.....				22	1,000	5	2,200		22		1,640	1	5	1,000		1	9	1,000		2,640	
Porto Rico.....	3	5	2,000	1	15	140	6	2,000				3	21	5,500	4	36	26,400		5,200		
Rhode Island.....				16	150	15	7,650				1	3	1	3	1	7	27	1,200		8,850	
South Carolina.....	5	25	150	1	13	41	258													9,150	
Tennessee.....	2	10	825	3	1	15	7,000													43,583	
Texas.....				24	188	15	25,000													7,425	
Utah.....				140	1,800	3	25,000													31,500	
Vermont.....	16	48	6,500	7	132	2,300	9	42,658	33	4,700										47,358	
Virginia.....				2	10	6	2,010													2,010	
Washington.....																					
West Virginia.....																					
Wisconsin ²																					
Wyoming ²																					
Total.....	168	659	48,465	71	2,106	40,305	767	995,220	459	574	130,917	16	162	23,730	310	291	125,361	1,323,693			

Comparative statement of farmers' institutes.

State or Territory.	Appropriation.				Number of sessions.				Number of institutes.				Attendance.						
	1908-9	1909-10	1910-11	1909-10	1910-11	1908-9	1909-10	1909-10	1908-9	1909-10	1909-10	1908-9	1909-10	1909-10	1910-11				
Alabama.....	\$1,400.00	\$600.00	\$1,300.00	(1)	71	48	(1)	24	(1)	31	28	(1)	4,240	3,555	(1)	3,681			
Alaska.....	123.36	1,250.00	1,351.24	(1)	75	95	(1)	34	(1)	43	51	(1)	1,862	3,647	(1)	6,779			
Arizona.....	4,635.60	4,500.00	5,000.00	90	95	95	70	267	93	100	69	44,161	32,000	11,061					
Arkansas.....	7,000.00	10,750.00	10,750.00		165	161	70	100	80	100	103	28,294	34,088						
California.....	9,342.42	5,000.00	5,239.00		90	82	55	55	48	22,560	30,560	34,117							
Colorado.....	(2)	5,000.00	5,000.00		23	23	24	(2)	24	24	24	9,210	10,680	5,930					
Connecticut.....	1,650.00	1,177.50	1,050.00	88	65	23	31	29	68	113	113	5,576	9,821	20,060					
Delaware.....	2,500.00	7,300.00	7,300.00	122	192	29	64	26	67	30	30	4,480	12,000	10,900					
Florida.....	7,000.00	7,500.00	10,500.00	(1)	96	96	(1)	64	(1)	67	(1)	(1)	(1)	(1)	(1)				
Georgia.....	(1)	2,500.00	4,111.10	149	72	43	51	43	111	163	102	8,560	11,500	8,991					
Hawaii.....	1,000.00	4,468.23	29,125.00	792	1,218	1,267	351	354	382	354	215,211	231,732	164,731						
Idaho.....	19,043.75	20,755.00	19,750.00	18,376.88	564	670	83	83	76	103,750	117,550	203,910	201,550	137,708					
Illinois.....	20,000.00	20,755.00	14,974.54	15,000.00	782	808	212	247	300	37,191	10,044	212	212	212	18,467	58,504			
Indiana.....	10,650.38	10,650.00	10,650.00	15,000.00	476	476	60	60	119	148	32	(1)	20,530	4,800					
Iowa.....	8,200.00	25,366.66	15,000.00	15,000.00	1,267	1,267	107	89	38	44	8,267	14,831	8,868						
Kansas.....	10,607.44	9,016.97	11,100.00	1,100.00	1,100	1,100	1,100	1,100	56	93	55	9,345	9,151	13,960					
Kentucky.....	(1)	2,000.00	1,100.00	1,100.00	1,100	1,100	1,100	1,100	118	136	137	20,756	23,664	21,812					
Louisiana.....	4,500.00	2,300.00	3,000.00	6,000.00	1,200	1,200	1,200	1,200	198	404	404	147,438	149,002	141,438					
Maine.....	6,000.00	6,000.00	4,000.00	4,000.00	1,200	1,200	1,200	1,200	1,200	1,200	1,200								
Maryland.....	4,000.00	4,000.00	8,923.62	8,923.62	8,500.00	8,500.00	1,136	1,136	1,136	1,136	1,136								
Massachusetts.....																			
Michigan.....																			

¹ No institute held.² No report.

Comparative statement of farmers' institutes—Continued.

State or Territory.	Appropriation.			Number of sessions.			Number of institutes.			Attendee.		
	1908-9	1909-10	1910-11	1909-10	1910-11	1908-9	1909-10	1910-11	1908-9	1909-10	1910-11	1908-9
Minnesota.....	23,500.23	21,705.99	20,985.00	639	602	332	266	218	109,625	100,723	114,746	31,199
Mississippi.....	5,000.00	16,000.00	15,000.00	243	347	118	137	205	25,229	31,199	46,880	14,550
Missouri.....	8,500.00	6,143.41	10,000.00	194	384	260	97	170	64,800	14,550	64,077	11,973
Montana.....	7,500.00	8,000.00	10,000.00	148	147	72	79	85	10,016	17,870	104,519	63,270
Nebraska.....	14,735.84	16,760.26	15,484.80	578	301	144	157	148	86,623	104,519	(1)	(1)
Nevada.....	(1)	1,200.00	1,600.00	(1)	36	30	(1)	12	13	1,800	3,000	(1)
New Hampshire.....	3,000.00	3,176.49	3,000.00	116	141	38	38	47	10,425	11,000	8,185	(1)
New Jersey.....	1,800.00	(1)	1,600.00	(1)	1,201	276	87	(1)	1,696	(1)	(1)	(1)
New Mexico.....	28,000.00	31,000.00	28,500.00	1,170	1,170	300	300	340	172,119	149,450	128,131	149,450
New York.....	6,400.00	7,500.00	7,500.00	469	775	294	209	372	46,500	40,004	49,989	49,989
North Carolina.....	9,855.22	10,417.81	9,435.23	233	237	94	94	87	46,538	31,606	41,317	31,606
Ohio.....	22,050.00	22,050.00	22,000.00	1,620	1,615	332	323	323	400,000	421,040	376,185	421,040
Oklahoma.....	4,800.00	21,700.00	5,000.00	(2)	72	280	142	115	11,933	80,000	5,320	11,933
Oregon.....	3,000.00	2,500.00	3,000.00	64	66	35	40	33	16,930	11,250	18,520	16,930
Pennsylvania.....	23,000.00	22,500.00	25,500.00	1,061	980	203	2,020	221	156,632	161,696	162,809	161,696
Porto Rico.....	(1)	1,000.00	(1)	9	(1)	10	9	(1)	700	420	(1)	(1)
Rhode Island.....	457.29	266.60	430.18	22	28	10	16	23	1,400	2,910	2,640	2,640
South Carolina.....	755.00	1,141.68	11,197.27	265	156	10	78	78	5,848	9,000	9,000	9,000
South Dakota.....	7,000.00	10,187.22	10,469.76	368	414	88	106	116	44,357	48,500	13,100	48,500
Tennessee.....	5,000.00	5,000.00	5,000.00	46	84	40	23	42	55,300	8,910	4,142	8,910
Texas.....	2,116.00	5,000.00	5,000.00	240	498	87	130	292	11,049	3,238	23,340	11,049
Utah.....	2,825.11	6,442.35	6,000.00	240	61	33	31	49	18,089	29,573	5,945	18,089
Vermont.....	1,000.00	1,500.00	3,750.00	65	83	5	37	50	600	5,190	7,660	5,190
Virginia.....	2,000.00	4,000.00	5,000.00	(2)	110	130	236	55	25,000	22,000	6,000	22,000
Washington.....	5,000.00	8,750.00	8,500.00	177	102	84	65	34	15,465	14,083	5,578	14,083
West Virginia.....	9,240.29	6,630.00	8,000.00	307	401	98	84	88	19,424	27,398	26,100	19,424
Wisconsin.....	20,000.00	20,000.00	20,000.00	660	751	140	133	178	93,000	100,519	113,666	100,519
Wyoming.....	1,633.18	1,737.34	1,000.00	98	10	20	17	2	4,463	4,463	676	4,463
Total.....	345,666.49	432,374.25	422,693.47	16,586	16,741	5,614	5,614	5,614	2,240,925	2,395,908	2,291,887	2,291,887

¹ No institute held.² No report.

Experiment Stat.

1810/11

